CLERK'S COPY.

Vol. I

TRANSCRIPT OF RECORD

(Pages 1 to 368)

Supreme Court of the United States

OCTOBER TERM, 1947

No. 280

FUNK BROTHERS SEED COMPANY, PETITIONER,

vs.

KALO INOCULANT COMPANY

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT

PETITION FOR CERTIORARI FILED AUGUST 19, 1947.

CERTIORARI GRANTED OCTOBER 13, 1947.

IN THE

Supreme Court of the United States

OCTOBER TERM, 1946.

No.

FUNK BROTHERS SEED COMPANY,

Petitioner,

vs.

KALO INOCULANT COMPANY,

Respondent.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

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IN THE

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FOR THE SEVENTH CIRCUIT

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Plaintiff-Appellant,

No. 9040 vs.

FUNK BROTHERS SEED COMPANY,
Defendant-Appellee.

KALO INOCULANT COMPANY,
Plaintiff-Appellee,

No. 9041 vs.

FUNK BROTHERS SEED COMPANY,
Defendant-Appellant.

Appeals from the District Court of the United States for the Southern District of Illinois, Southern Division.

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No. 1,099,121—G. H. Earp-Thomas, June 2, 1914..... 786
No. 1,106,275—W. B. Bottomley, Aug. 4, 1914..... 790
No. 1,252,332—G. H. Earp-Thomas, Jan. 1, 1918..... 792
No. 1,309,723—G. H. Earp-Thomas, July 15, 1919.... 798
No. 1,320,701—Thomas F. Manns, Nov. 4, 1919..... 804

1 Pleas in the District Court of the United States of America within and for the Southern Division of the Southern District of Illinois, held at the City of Quincy in said Division and District before the Honorable J. Leroy Adair, Judge of said Court, on Monday, the 5th day of March in the year of our Lord One Thousand Nine Hundred and Forty-Five and of the Independence of the United States of America, the One Hundred Seventieth year.

Present: J. Leroy Adair, District Judge
Robert Grant, United States Marshal
Howard L. Doyle, United States Attorney
G. W. Schwaner, Clerk

Attest:

G. W. Schwaner, Clerk.

2 IN THE DISTRICT COURT OF THE UNITED STATES,
For the Southern District of Illinois,
Southern Division.

KALO INOCULANT COMPANY,
a corporation,
Plaintiff,
vs.
FUNK BROTHERS SEED COMPANY,
a corporation,
Defendant.
} Civil Action No. Q-62.

Be it remembered that heretofore to-wit: on the 10th day of December, in the Year of our Lord One Thousand Nine Hundred and Forty-three, that being one of the days of the September A. D. 1943 Term of the District Court of the United States for the Southern Division of the Southern District of Illinois at Quincy, there was filed in the office of the Clerk of said Court a certain Complaint for Infringement of United States Letters Patent which said Complaint was and is in the words and figures following, to-wit:

3 IN THE DISTRICT COURT OF THE UNITED STATES,
Southern District of Illinois,
Southern Division.

KALO INOCULANT COMPANY,
a corporation,
Plaintiff,
vs.
FUNK BROTHERS SEED COMPANY,
a corporation,
Defendant.
} Civil Action No. Q-62.

COMPLAINT FOR INFRINGEMENT OF UNITED STATES LETTERS PATENT NO. 2,200,532.

EQUITABLE RELIEF DEMANDED.

I.

(a) Plaintiff is a corporation incorporated under the laws of the State of Illinois, and is a citizen of that

State, having its principal place of business at Quincy, Illinois.

(b) Defendant is a corporation incorporated under the laws of the State of Illinois, and is a citizen of that State, having its principal place of business at Bloomington, Illinois.

II.

(a) This action arises under the Patent Laws of the United States as hereinafter more fully appears.

(b) The acts of infringement hereinafter complained of were and are being committed within the Southern Judicial District of Illinois, Southern Division, and elsewhere within the United States.

4

III.

(a) On May 14, 1940, Varley Sherman Bond being, within the meaning of the patent statutes in force, the original and first inventor of certain improvements in Bacterial Inoculant or Leguminous Plants, and all of the requirements of the then statutes and rules of the Patent Office having been complied with, United States Letters Patent No. 2,200,532 for said inventions were duly and legally issued to plaintiff as assignee of said Varley Sherman Bond.

(b) Since the issuance thereof plaintiff has been and is now the sole owner of all right, title and interest in and to said letters patent No. 2,200,532 and of all rights of recovery thereunder.

IV.

Defendant has been, subsequent to the date of issuance of the said letters patent No. 2,200,532 and prior to the filing of this Complaint, and still is infringing said letters patent and contributing to the infringement of said letters patent by causing to be made, selling or causing to be sold, and using or causing to be used within the Southern District of Illinois, Southern Division, and elsewhere in the United States, a product known as LEGUME-AID INOCULANT embodying the inventions described and claimed in said letters patent, and will continue to do so unless enjoined by this Court.

V.

The required statutory notice has been placed on all inoculant manufactured and sold by plaintiff or by persons authorized by plaintiff under said letters patent, and plaintiff has given written notice to defendant of his infringement thereof but defendant has refused and neglected to discontinue said infringement.

WHEREFORE, plaintiff demands:

(a) That defendant, his agents, servants and employes be enjoined during the pendency of this action and permanently from directly or indirectly making or causing to be made, selling or causing to be sold, or using or causing to be used, any inoculant made in accordance with and embodying the inventions described and claimed in said letters patent No. 2,200,532, or from infringing upon or violating said letters patent in any way whatsoever.

(b) That defendant be required to pay plaintiff such damages as plaintiff has sustained in consequence of the infringement of said patent and to account and pay over to plaintiff all the profits derived by defendant from his infringement of plaintiff's patent;

(c) That defendant pay to plaintiff the costs of this action; and

(d) That plaintiff have such other and further relief as is just.

KALO INOCULANT COMPANY,
By (signed) M. E. LUSK,
Its President.

Thiess, Olson & Mecklenburger,
J. Bernhard Thiess,
C. L. Marx,
M. Hudson Rathburn,
77 W. Washington Street,
Chicago, Illinois.
Chester A. Groves,
W.C.U. Building,
Quincy, Illinois.
Attorneys for Plaintiff.

6 STATE OF ILLINOIS }
COUNTY OF ADAMS } ss:

M. E. Lusk, being first duly sworn on oath, deposes and says that he is the President of KALO INOCULANT COMPANY, the plaintiff named in the foregoing action; that he has read the foregoing Complaint and has subscribed the same on behalf of said corporation; that the statements and facts therein contained are accurate and true of his own knowledge and to the best of his information and belief. This verification is not made by the plaintiff personally because the said plaintiff is a corporation.

(Signed) M. E. Lusk.

Subscribed and sworn to before me this 10th day of December, A.D., 1943.

(signed) Chester A. Groves,
Notary Public.

My commission expires January 4, 1947.

(SEAL)

Endorsed, Filed,
December 10, 1943
G. W. Schwaner, Clerk.

7 And afterwards, to-wit: on the 26th day of January, A. D. 1944, there was filed in the office of the Clerk of said Court in said cause a certain Answer and Counter-Claim of Defendant which said Answer and Counter-Claim was and is in the words and figures following to-wit:

8 IN THE DISTRICT COURT OF THE UNITED STATES

• • (Civil Action No. Q-62) • •

ANSWER AND COUNTERCLAIM OF DEFENDANT.

I.

Now comes the Defendant in the above entitled cause, Funk Brothers Seed Company, by its attorneys of record, and for Answer to the Bill of Complaint filed herein says that it admits that the Plaintiff is a corporation incorporated under the laws of the State of Illinois and a

citizen of that State, having its principal place of business at Quincy, Illinois, as alleged in subparagraph a of paragraph 1 of the Bill of Complaint filed herein.

It is also admitted that the Defendant is a corporation incorporated under the laws of the State of Illinois and is a citizen of that State having its principal place of business at Bloomington, Illinois, as alleged in subparagraph b of paragraph 1 of said Bill of Complaint.

II.

The Defendant admits that this action arises under the patent laws of the United States but denies that it has committed, is now committing, or intends to commit any act of infringement within the Southern Judicial District of Illinois, Southern Division, or elsewhere within the United States and specifically denies the allegations of subparagraph b of paragraph 2 of the Bill of Complaint.

III.

(a) The Defendant admits that United States Letters Patent No. 2,200,532 were issued by the Commissioner of Patents of the United States to the Plaintiff as assignee of Varley Sherman Bond under date of May 14, 1940, but the Defendant denies that said Letters Patent were duly or legally issued and specifically denies all the other allegations of subparagraph a of paragraph 3 of the Bill of Complaint herein.

(b) The Defendant further admits that the Plaintiff herein is now the sole owner of said Letters Patent No. 2,200,532 but denies that there are any rights of any character under the law conferred by said Letters Patent and particularly denies that there are any rights of recovery under said Letters Patent either in the Plaintiff or anyone else.

IV.

The defendant denies that it has committed at any time or is now committing any act of infringement as to said Letters Patent No. 2,200,532 or contributed to the infringement of said Letters Patent in any way within the Southern District of Illinois, Southern Division or

elsewhere in the United States and specifically denies all the allegations of paragraph 4 of the Bill of Complaint herein.

V.

The Defendant having no knowledge of the placing of the required statutory notice on all inoculants manufactured and sold by the Plaintiff as alleged in para-
11 graph 5 of the Bill of Complaint herein other than as contained in said Bill of Complaint, upon information and belief denies the allegations of said paragraph 5 of said Bill of Complaint as to said placing of notice upon the products manufactured by the Plaintiff and calls upon the Plaintiff to prove the same. The Defendant admits, however, that the Plaintiff has served a written notice upon it claiming an alleged act of infringement as to said patent No. 2,200,532 but the Defendant denies that it has committed any act of infringement as to said Letters Patent.

VI.

The Defendant denies each and every allegation of the Bill of Complaint filed herein not heretofore specifically denied or admitted and denies that the Plaintiff is entitled to any relief in law or equity against the Defendant.

VII.

Further answering the Defendant avers and shows to the Court that the Bill of Complaint filed herein fails to state any claim against the Defendant upon which relief could be granted either in law or equity.

12 VIII.

Further answering the Defendant is informed and, therefore, avers that the patentee of said patent in suit No. 2,200,532, to-wit, Varley Sherman Bond, was not the sole original or first inventor or discoverer of any material or substantial part of the alleged invention or inventions described or claimed in said Letters Patent but on the contrary that the invention or inventions de-

scribed and claimed in said patent here in suit and every material and substantial part thereof was shown, disclosed, described or patented prior to the alleged invention or inventions or discovery thereof by said Varley Sherman Bond, or more than two years prior to his application for patent therefor in the following patents and publications, to-wit:

Number	Inventor	Date
865,965	Earp-Thomas	Sept. 10, 1907
899,155	Coates	Sept. 22, 1908
982,569	Bottomley	Jan. 24, 1911
1,002,248	Ellis	Sept. 5, 1911
1,099,121	Earp-Thomas	June 2, 1914
1,106,275	Bottomley	Aug. 4, 1914
1,252,332	Earp-Thomas	Jan. 1, 1919
13 1,289,565	Snelling	Dec. 31, 1918
1,309,723	Earp-Thomas	July 15, 1919
Re.14,686	Earp-Thomas	July 15, 1919
1,320,701	Manns	Nov. 4, 1919
1,355,732	Bottomley	Oct. 10, 1920
1,442,239	Stoltz	Jan. 16, 1923
1,618,461	Matchette	Feb. 22, 1927
1,938,647	Earp-Thomas	Dec. 12, 1933
2,098,918	Henrickson	Nov. 9, 1937

PUBLICATIONS.

"Bacteriology" by Buchanan, published by MacMillan Company, New York City, 1938, pages 120 to 123 inclusive.

"Root Nodule Bacteria and Leguminous Plants" by Edwin Broun Fred, Ira Lawrence Baldwin and Elizabeth McCoy, published by the University of Wisconsin, in 1932, pages 25, 37, 44, 45, 114, 135, 136, 244 and 245 inclusive thereof.

"Laboratory Manual of General Microbiology" by Fred and Waksman, published by McGraw-Hill Book Company, Inc., 370 Seventh Avenue, New York City, 1928, pages 16 and 33 thereof.

14 "The Alphano Book", published by The Alphano Humus Company, Whitehall Building, 17 Battery Place, New York City, in 1916 and particularly pages 20 and 21 thereof.

Booklet published and distributed by The Alphano Humus Company of Whitehall Building, 17 Battery Place, New York City, in 1916 in connection with a product of that company advertised under the trade name of "The All-In-One Inoculant".

Booklet entitled "Furguson's Composite Culture of Nitrogen-Fixing Bacteria" published by the Homewood Nitrogen Company, 55 Liberty Street, New York City, May 1, 1913.

Booklet entitled "Nitrogen From The Air Converted Into Food For Plants", published by the Homewood Nitrogen Company, 55 Liberty Street, New York City, June 10, 1914, and also other patents and publications which Defendant is informed and believes are in existence but which it has not yet ascertained and which as soon as known or located, Defendant prays leave to insert herein by proper amendment.

IX.

Further answering Defendant is informed and believes and, therefore, avers that the patent here in suit is wholly invalid and void because the alleged invention or inventions described and claimed in said patent and every material and substantial part thereof had been invented, produced and used and was known to others in this country prior to the alleged invention and discovery thereof by said Varley Sherman Bond or in public use or on sale in the United States for more than two years prior to the application of said Varley Sherman Bond for said patent in suit by the patentees of the various patents set forth in paragraph VIII hereof and by the following named persons, firms or corporations at the following named places, to-wit:

Kalo Inoculant Company, the Plaintiff herein through its officers, agents and employees at Quincy, Illinois.

McQueen Bacteria Company, through its officers, agents and employees at Baltic, Ohio.

The Albert Dickinson Company, through its officers, agents and employees at Chicago, Illinois.

Agricultural Laboratories, Inc., through its officers, agents and employees at Columbus, Ohio.

The University of Wisconsin, through its officers,

agents and employees at Madison, Wisconsin, and by other persons, firms and corporations and at other places at this time unknown to Defendant but which Defendant prays leave to insert herein by suitable amendment as soon as known.

X.

Further answering Defendant is informed and believes and, therefore, avers that the said patent in suit discloses no patentable invention over or in view of the state of the art at and prior to the time application for said patent in suit was filed; that the subject matter of the patent in suit, in view of the then existing prior art, involves and constitutes nothing but unpatentable aggregations and exhausted combinations of parts, elements, steps or details and that such subject matter did not require any exercise of invention and differs from the prior art, if any difference exists, in immaterial and unpatentable details not requiring invention under the patent laws of the United States.

XI.

Defendant further answering avers on information and belief that there is no real invention or novelty in the alleged patent in suit and that the alleged invention or improvement set forth in the claims and specifications forming part of said Letters Patent is not the statutory subject of invention and is not any new and useful art within said statutes in such case made and provided and the said alleged method or process or article is not patentable subject matter under said statutes, the alleged invention of the patentee of the patent in suit merely pointing out the way by use of a natural condition of nature's laws and said patentee not inventing any new process, chemical or otherwise, or article, machine or device whereby the force of nature is controlled.

XII.

Further answering Defendant is informed and believes and, therefore, avers that the specifications of the patent here in suit is ambiguous, incomplete and indefinite, and does not describe the manner of using or practicing the

alleged invention claimed to be disclosed in said patent in suit with such adequacy as is required by the statutes in such cases made and provided, or which would enable any person skilled in the art to make and use the alleged invention purported to be disclosed in said patent and, therefore, said patent is wholly invalid and void.

18 XIII.

Further answering Defendant is informed and believes and, therefore, avers that said patent here in suit was unlawfully obtained and issued by the United States Patent Office without due investigation and that an important part of the relevant prior art hereinbefore set forth was overlooked and other parts of said prior art were improperly implied and construed and that representations made in the specifications of said patent in suit are not based upon fact or truth; wherefore, the Commissioner of Patents exceeded his legal authority in granting the aforesaid Letters Patent and that said patent is, therefore, wholly invalid, void and of no effect.

WHEREFORE, Defendant denies that the Plaintiff is entitled to the relief prayed for in the Complaint, or to any relief, and prays to be hence dismissed with its costs in this cause sustained, and for such other and further relief as to the Court may seem just.

COUNTERCLAIM.

And by way of Counterclaim against the Plaintiff, Kalo Inoculant Company, the Defendant, Funk Brothers Seed Company, now says:

19 (1) The defendant avers that the cause of action set forth in this Counterclaim arises under the patent laws of the United States and involves an actual controversy within the meaning of the Declaratory Judgment Act of 1934, Section 274 (d) of the Judicial Code of the United States, 28 U. S. C. A. 400, between the Plaintiff and the Defendant herein both as to the validity of United States Letters Patent No. 2,200,532 sued on herein in the Bill of Complaint of the Plaintiff and as to the infringement by the Defendant of the rights alleged to be possessed by the Plaintiff herein by virtue of the grant of said Letters Patent No. 2,200,532.

(2) The Defendant by way of asking for affirmative relief, avers that said patent in suit No. 2,200,532 is wholly null and void and invalid in law as to all claims thereof for the reasons set forth in the above and foregoing Answer of the Defendant filed herein, which said Answer the Defendant does now adopt and make a part of this its Counterclaim, the same as if set forth herein verbatim, and that the Defendant has not in any way committed or threatened to commit any act of infringement as to said patent in suit No. 2,200,532.

Wherefore, the Defendant prays as follows:

20 (a) For a Declaratory Judgment under the provisions of the Declaratory Judgment Act of 1934, Section 274 (d) of the Judicial Code of the United States, 28 U. S. C. A. 400, decreeing and adjudging said patent in suit No. 2,200,532 both invalid in law as to all its claims and not infringed by the Defendant.

(b) For an injunction enjoining and restraining the Plaintiff from directly or indirectly instituting, bringing or maintaining any further litigation against this Defendant or its customers under said patent in suit No. 2,200,532.

(c) That the Defendant have judgment against the Plaintiff for its costs herein and for such other and further relief in the premises as to the Court may seem meet and just and to which the Defendant may be entitled.

FUNK BROTHERS SEED COMPANY,
By (Sgd) J. R. Holbert,
Vice Pres. & Genl. Mgr.

STATE OF ILLINOIS }
COUNTY OF McLEAN } ss:

J. R. Holbert, being first duly sworn on oath, deposes and says that he is the Vice Pres. & Genl. Mgr. of FUNK BROTHERS SEED COMPANY, and has read the foregoing
21 Answer and Counterclaim and has subscribed the same on behalf of said Corporation; that the statements and facts therein contained are accurate and true of his own knowledge to the best of his information and belief. This verification is not made by the Defendant personally because the said Defendant is a corporation.

(Signed) J. R. Holbert.

Subscribed and sworn to before me this the 22nd day of January, A. D. 1944.

(Sgd) Elias W. Rolley,
Notary Public.

(Seal)

Toulmin & Toulmin) Address 308 W. First St.
Rowan A. Greer) Dayton, Ohio
Harold W. Lewis Address Stern Bldg., Quincy, Ill.
Attorneys for Defendant
and Cross-Complainant.
Endorsed, Filed,
January 26, 1944,
G. W. Schwaner, Clerk.

22 And afterwards, to-wit: on the 14th day of February, 1944, there was filed in the office of the Clerk of said Court in said cause a certain Plaintiff's Reply to Counterclaim of Defendant which said Plaintiff's Reply to Counterclaim was and is in the words and figures following, to-wit:

23 IN THE DISTRICT COURT OF THE UNITED STATES

* * (Civil Action No. Q-62) * *

PLAINTIFF'S REPLY TO COUNTERCLAIM OF DEFENDANT.

Plaintiff, Kalo Inoculant Company, for its reply to the Counterclaim of Defendant, filed on or about January 26, 1944, says:

I.

Plaintiff denies each and every allegation contained in Paragraphs (1) and (2) of the Counterclaim of Defendant filed herein, denies each and every allegation set forth in the Answer of Defendant filed herein and included by reference in Paragraph (2) of the Counterclaim, and denies that the said Bond patent in suit, No. 2,200,532, is wholly or in any part null or void or invalid in law as to any of the claims thereof for any reason.

II.

Further replying to the Counterclaim of Defendant, plaintiff now adopts and makes a part of this reply to the said Counterclaim, the same as if set forth verbatim in this reply, Paragraphs III, IV, and V of its Complaint herein.

III.

Plaintiff avers that the Counterclaim of Defendant fails to state a claim upon which relief can be granted under the Patent Laws of the United States or under the Declaratory Judgment Act of 1934, Section 274(d) of the Judicial Code of the United States, 28 U.S.C.A. 400; and denies that defendant is entitled to any of the relief sought and prayed for in the said Counterclaim or to any relief whatsoever in this cause; and plaintiff prays that the said Counterclaim be dismissed for want of equity and that costs be assessed and taxed against the defendant.

(signed) Thiess, Olson & Mecklenburger,
Attorneys for Plaintiff.

(signed) J. Bernhard Thiess,
(signed) M. Hudson Rathburn,
77 West Washington Street,
Chicago, Illinois.

(signed) Chester A. Groves,
W. C. U. Building,
Quincy, Illinois.
Of Counsel.

A copy of the foregoing Reply to the Counterclaim of Defendant received this 14th day of February, 1944.
(signed) Harold W. Lewis,
Attorneys for Defendant.

Endorsed, Filed,
February 14, 1944,
G. W. Schwaner, Clerk.

25 And afterwards, to-wit: on the 28th day of October, 1944, there was filed in the office of the Clerk of said Court in said cause a certain Amended Answer of Defendant which said Amended Answer was and is in the words and figures following, to-wit:

26 IN THE DISTRICT COURT OF THE UNITED STATES

(Civil Action No. Q-62)

AMENDED ANSWER OF DEFENDANT.

Now comes Funk Brothers Seed Company, Defendant in the above entitled action, by its attorneys of record and moves the Court for leave to amend the answer of the Defendant heretofore filed herein as follows:

1. By adding to the prior publications as pleaded in Paragraph VIII of the answer heretofore filed herein the following:

Bulletin No. 115 published by the Delaware College Agricultural Experiment Station at Newark, Delaware, dated December, 1916 and entitled "A Preliminary Report on Muck Humus as a Fertilizer and Carrier of Beneficial Soil Bacteria" by Thomas F. Manns and Joseph M. Goheen and particularly pages 6, 25, 27, 38 and 40 and plate illustration No. VII of said publication.

2. By adding to Paragraph IX of the answer heretofore filed herein the following prior users at the end of said paragraph IX of said original answer:

The Kalo Company of Quincy, Illinois, predecessor of the Plaintiff herein, through its officers, agents and employees at Quincy, Illinois.

27 The Earp-Thomas Laboratories, Inc. of Bloomfield, New Jersey, through its officers, agents and employees at Bloomfield, New Jersey.

The Nitrogen Company of Milwaukee, Wisconsin, through its officers, agents and employees at Milwaukee, Wisconsin.

The Earp-Thomas Cultures Corp. of Long Island City, New York, through its officers, agents and employees at Long Island City, New York, in connection with the manufacture and sale of a composite culture under the name of All Crop Farmogerm.

3. By adding the following paragraph numbered XIV

immediately following Paragraph numbered XIII on page 11 of the original answer filed herein as follows:

XIV. The Defendant further answering, avers and shows to the Court that the Bond patent in suit No. 2,200,532 was surreptitiously obtained by the patentee thereof through erroneous and false statements to the effect that it has been previously considered that the nitrogen fixing ability of Rhizobium trifolii in symbiotic relationship with red clover is markedly inhibited if strains of Rhizobium meliloti, Rhizobium japonicum, or other species of Rhizobium were present within the same inoculant and by further falsely representing and stating to the Patent Office that composite cultures for inoculating the seeds of leguminous plants have not generally come into use because of the inhibitory effect that certain strains of certain species of the Rhizobium have on each other and also because no method has been developed whereby a composite culture may be produced wherein a sufficient number of each species of organism in the inoculant is insured. The Defendant is advised and believes that these statements were false and contrary to the fact and were the cause inducing the Patent Office to grant the said Letters Patent in suit, No. 2,200,532 and that as a consequence, the Plaintiff in this action does come into Court with unclean hands and should be repelled and held to be without any remedy from a Court of justice.

FUNK BROTHERS SEED COMPANY,
By (signed) Toulmin & Toulmin,
Attorneys.

(signed) Rowan A. Greer
Solicitors and of Counsel.

Filing of above and foregoing amended answer is consented to without prejudice.
(signed) Thiess, Olson & Mecklenburger,
Attorneys for Plaintiff.

Leave for filing above and foregoing amendment to answer of Defendant granted.
Dated this 28th day of October, 1944.

(signed) J. Leroy Adair,
United States District Judge.

Endorsed, Filed,
October 28, 1944,
G. W. Schwaner, Clerk.

29 And afterwards, to-wit: on the 30th day of April, 1945, the following further proceedings were had in said Court in said Cause and were entered of record as follows:

30 In the District Court of the United States

• • (Civil Action No. Q-62) • •

It is hereby ordered by the Court that said cause be set for trial at Quincy, Illinois, on Monday, May 28, 1945, at 10:00 o'clock A. M.

31 And afterwards, to-wit: on the 14th day of May, 1945, the following further proceedings were had in said Court in said cause and were entered of record to-wit:

32 In the District Court of the United States.

• • (Civil Action No. Q-62) • •

This cause coming on this day to be heard upon the motion of the Plaintiff to vacate the setting of said cause for trial on May 28, 1945, and for a resetting thereof on June 25, 1945, and the court having heard and duly considered the said Motion, it is ordered that the said Motion be and is hereby allowed.

It is, therefore,

Ordered by the Court that the setting of May 28, 1945, be and is hereby vacated and that said cause be and is hereby reset for trial on Monday, June 25, 1945 at 10:00 o'clock A. M. at Quincy, Illinois.

33 And afterwards, to-wit: on the 25th day of June, A. D. 1945, there was filed in the office of the Clerk of said Court in said cause a certain Stipulation which said Stipulation was and is in the words and figures following, to-wit:

34 IN THE DISTRICT COURT OF THE UNITED STATES.

(Civil Action No. Q-62)

STIPULATION.

In order to facilitate the trial of the above entitled cause it is stipulated by the parties as follows:

1. That either party may introduce into evidence uncertified Patent Office printed copies or photostatic copies of Letters Patent of the United States or any foreign country at the trial with the same force and effect as if certified copies of said Letters Patent were offered subject to correction, as to errors, if any, by comparison with said certified copies or originals.

2. That either party may introduce into evidence at the trial photostatic copies of printed articles, books or pamphlets with the same force and effect as if the
35 originals were offered in evidence and that the dates appearing thereon may be regarded as the dates of publication subject to correction as to errors, if any, by comparison with the originals of said documents.

3. That the bill of the stenographer for services rendered in attendance and furnishing the original transcript of the proceedings of the trial to the Court may be paid for, one-half by the Plaintiff and one-half by the Defendant, the total amount of said bill however, to be taxed as part of the taxable cost of the action. Any copy or copies of the proceedings furnished to either party for its own use shall be paid for by the party so ordering such copy or copies and is not to be taxed as cost in the case.

(signed) Thiess, Olson & Mecklenburger,
Attorneys for Plaintiff.

Chicago, Illinois,
June 14, 1945.

(signed) Toulmin & Toulmin,
Attorneys for Defendant.

Dayton, Ohio,
June 7, 1945.

Endorsed, Filed,
June 25, 1945,
G. W. Schwaner, Clerk.

36 And afterwards, to-wit: on the 25th day of June, A. D. 1945, there was filed in the office of the Clerk of said Court in said cause a certain Stipulation which said Stipulation was and is in the words and figures following, to-wit:

37 IN THE DISTRICT COURT OF THE UNITED STATES.

(Civil Action No. Q-62)

STIPULATION.

It is stipulated by the parties that the claims of the Bond Patent in suit No. 2,200,532 which will be relied upon by the Plaintiff at the trial are claims 1, 3, 4, 5, 6, 7, 8, 13 and 14.

(signed) Thiess, Olson & Mecklenburger,
Attorneys for the Plaintiff.

Chicago, Illinois,
June 14, 1945.

(signed) Toulmin & Toulmin,
Attorneys for the Defendant.

Dayton, Ohio,
June 11, 1945.
Endorsed, Filed,
June 25, 1945,
G. W. Schwaner, Clerk.

38 And afterwards, on to-wit: the 4th day of August, A. D. 1945, there was filed in said cause, the Record of Proceedings at the Trial, which said Record of Proceedings was and is in the words and figures, following, to-wit:

61 IN THE DISTRICT COURT OF THE UNITED STATES.

(Civil Action—No. Q-62)

REPORT OF PROCEEDINGS AT TRIAL

in the above-entitled action before Honorable Charles G. Briggle, Judge of said Court, at Quincy, Illinois, commencing on Monday, June 25, 1945.

Appearances:

Messrs. Thiess, Olson & Mecklenburger,
By: J. Bernhard Thiess, Esq.,
M. Hudson Rathburn, Esq. and
Sidney Neuman, Esq.,
77 West Washington Street, Chicago, Illinois,
and
Chester A. Groves, Esq.,
W. C. U. Building, Quincy, Illinois,
on behalf of Plaintiff;

Messrs. Toulmin & Toulmin,
By: Rowan A. Greer, Esq. and D. C. Staley, Esq.,
308 West 1st Street, Dayton 2, Ohio.

Harold W. Lewis, Esq.,
Stern Building, Quincy, Illinois,
and
David Davis, Esq.,
Bloomington, Illinois,
on behalf of Defendant.

62 IN THE DISTRICT COURT OF THE UNITED STATES.

The Court: You may proceed.

Mr. Thiess: If your Honor please, I would like to call Mr. Curie to the stand, of the Agricultural Bacteria Laboratories, Inc., as a hostile witness.

IRVIN HAROLD CURIE, called as a witness herein
63 by the plaintiff, being first duly sworn, was examined and testified as follows:

Examination by Mr. Thiess.

Q. Mr. Curie, will you please give your full name and your present residence?

A. Irvin Harold Curie.

Q. Where do you live?

A. At 110 North Orchard Lane, Columbus, Ohio.

Q. How are you presently employed?

A. By Agricultural Laboratories, Incorporated.

Q. In what capacity?

A. As soil biologist of the firm.

Q. What are your duties as the soil biologist of that firm?

A. It involves superintending the manufacture of the product and carrying on such research as may be desirable to improve the product.

Q. And as soil biologist of this firm, you are in charge, are you, of the manufacture of Legume-Aid that is put out by that company?

A. I am.

Q. I would like to show you a package marked
64 "Legume-Aid" and ask you whether that is the Legume-Aid that is put out by the Agricultural Laboratories, Inc?

A. It is.

Mr. Thiess: I would like to offer this package in evidence as Plaintiff's Exhibit No. 1.

The Court: It may be marked.

(Said package marked "Legume-Aid" was thereupon marked as Plaintiff's Exhibit No. 1, for identification.)

The Court: It may be received.

(Said package was thereupon received in evidence by the Court, as aforesaid, and marked as Plaintiff's Exhibit No. 1.)

Mr. Thiess: Q. Now, in the manufacture of this Legume-Aid, are there any nutrients added to the base in which the bacteria are contained, that is, the humus?

A. There are nutrient materials added.

Q. And to what extent are nutrients added to this humus?

A. To a very slight extent added. The nutrients that are in the solution that goes in with the bacteria con-
65 tains nutrient—that solution contains nutrient material from the agar; that is taken from the agar. There is bound to be some.

Q. Then, the nutrient that you introduce is the nutrient that comes from the agar where the bacteria are multiplied and produced?

A. Yes.

Q. Well, how much nutrient would you say that was?

A. Sufficient to stimulate growth in the humus material.

Q. Well, can you give me how much?

A. I cannot.

Q. You do not know how much you put in it?

A. No.

Q. You have never made a test to ascertain that?

A. No.

Q. So, as far as your company is concerned, they do not know at present how much nutrient you put into this Legume-Aid, in addition to that which is contained in the humus?

A. No, not in terms of chemical analysis.

Q. Now, did I understand you to say that you depend upon the growth of the bacteria in the composite culture?

A. We do not depend upon it. It is there.

66 Q. But you do not know to what extent it is there?

A. We have made such determinations.

Q. Didn't you just tell me that you didn't know how much of that nutrient that you had in it?

A. I beg your pardon. I understood you to ask for the amount of growth that takes place.

Q. Do you know how much of the nutrient that is in there?

A. No.

Q. Now, how is the nutrient solution prepared?

A. By growing the bacteria, as is common knowledge and exposed in the patent, on nutrient agar by methods commonly known.

Q. In other words, you prepare your nutrient solution in the same way as that which is explained in the patent in suit?

A. We do.

Q. And if you got any nutrient in your final Legume-Aid it would be the nutrient that comes out of that solution that is made in that sort of way?

A. That nutrient would be there.

Q. Now, do you have any knowledge of the number of alfalfa and clover bacteria per cubic centimeter in the Legume-Aid solution?

A. It would be easier to state that in the terms of the number that we put in per package, and I do have
67 that knowledge.

Q. What would you say as to that?

A. In the combination package we put in approximately 9 to 10 billion of alfalfa per standard unit, and 14 billion of clover per standard unit.

Mr. Greer: Q. What was it for the clover? I did not get it?

A. About fourteen billion per standard unit.

Mr. Thiess: Q. And that is the amount you put in and which is contained in the solution before it is mixed with the humus?

A. It is.

Q. Now, I believe you said that you tested the amount of growth, is that correct?

A. We have done so.

Q. And what do you find in these tests?

A. We find that the bacteria multiply in the humus after it has been mixed.

Q. To what extent?

A. Approximately 40 times as many, at one time.

Q. How were these tests conducted that you made?
68 A. Those tests were conducted on plates of agar medium, agar jell.

Q. I don't quite follow you. How would you tell about the growth in the Legume-Aid under those circumstances, the growth of the bacteria?

A. It isn't an absolute test, because you are not always certain of one species of bacteria. I can't tell as to the number of alfalfa or clover after the growing period.

Q. Now, "after the growing period," what do you mean by that, Mr. Curie?

A. I mean that after we have mixed our culture with the humus, we allow it to grow for a period of five days before packaging, to encourage this growth in the humus.

Q. Then, after that, you package it and you don't know how much growth there might be after?

A. We do not know the actual number.

Q. And you do not know the actual number during that five-day period, exactly?

A. Not exactly.

The Court: Q. What do you mean by the humus? Is that what you mix it with?

A. That is the black—it is, you might say, a mock soil.

69 The Court: Q. It is the soil?

A. Or the black material underneath.

Q. It is the base, is that right?

A. Yes, it is the base of the mixture.

Q. That might be a number of different things, I suppose, might it not?

A. It may, and is not one material alone.

Q. Well, you use, you say, sort of a black soil?

A. We use that— The humus base includes both the humus and a proportion of charcoal.

Q. I suppose other bases could be used, could they, or could they not?

A. They have been. The humus base has come to be generally used because it has supported the growth of the bacteria in the best nature.

The Court: That is all.

Mr. Thiess: That is all.

Examination by Mr. Greer.

Q. As I understood you, you had conducted tests that showed, after you put the bacteria in the base, there was a further growth for development of the bacteria in that base, is that correct?

70 A. That is true.

Q. But you cannot say accurately as to how much that increase of growth extended?

A. No, no.

The Court: Q. I understood you approximated it at 40 times?

A. Yes, some— There have been tests which indicate that. That figure comes to my mind, that I know that that is what has occurred.

Q. Was that before it was packaged?

A. That is before it was packaged.

Q. Well, will it continue to grow after it is packaged?

A. Other tests that we have run indicate that there is very little change in the number after it is in the closed package.

Mr. Greer: Q. I understood you to say, and I ask you to correct me if I did not hear you accurately, that there was nutrient value, bacteria nutrient value in the solution which contained the bacteria, when you put them in the base?

A. Yes, and also in the base.

Q. That is what I did not understand you to say. Before you put the bacteria in the base, was or was
71 not any bacteria nutrient in the base itself?

A. Yes, there is.

Q. And what was that base composed of?

A. This mixture of peat and charcoal, or peat and charcoal, peat humus.

Q. Your base is one, then, that is composed of peat and charcoal?

A. Yes.

Q. And it does have bacteria nutrient value in it?

A. It does, or they would not multiply in the material.

Q. Now, you have been speaking of this Legume-Aid combination inoculant, have you not?

A. Yes.

Q. How long have you been following that process and producing this?

A. The combination culture has been produced since 1941.

Mr. Greer: Now, may it please Your Honor, so far as this cross-examination is concerned, I don't think I have anything more, but of course I expect to call Mr. Curie as a witness for the defendant as to other matters.

The Court: Will you have him explain just a little more as to what he means by bacteria nutrient?

72 Mr. Greer: Q. Just tell the Court, what do you mean by bacteria nutrient?

A. These bacteria are in effect a miniature plant, a one-cell plant, and accordingly they need, we might say, fertilization.

Q. Wouldn't "food" be the correct term?
A. They need food and they need phosphates.
Q. And you mean by nutrient the food they feed upon?
A. Yes. In other words, this mixture contains food for the bacteria.
Mr. Greer: Does that clear it in Your Honor's mind?
The Court: Yes.
What is the term counsel used this morning in telling the quality that causes them not to conflict with one another?
Mr. Greer: Inhibition.
The Court: What?
Mr. Greer: Inhibition.
The Court: Yes.
Q. Is there something put into the product to cause it to nullify itself with reference to the different kinds of bacteria?
73 A. There is nothing added in any way. It is prepared exactly as a culture for alfalfa.
Q. What is it that causes the inhibition that counsel speak of?
A. Your Honor, I do not know of any such inhibition.
Mr. Greer: You see, that is our position, that there is no inhibition.
The Court: I am getting into something that is not brought out—that is not cross-examination, of course. All right, go ahead.
Mr. Greer: No further cross-examination.
Mr. Thiess: That is all.
74 Mr. Rathburn: I now want to offer in evidence as Plaintiff's Exhibit Number 2 a soft copy of the Bond Patent in suit, No. 2,200,532.
The Court: It may be received.
(Said copy of Bond Patent No. 2,200,532, of May 14, 1940, on Bacterial Inoculant for Leguminous Plants, so offered and received in evidence, was marked as Plaintiff's Exhibit Number 2.)
Mr. Rathburn: The Plaintiff served on the defendant shortly after the case was at issue 40 interrogatories. To most of them we did not get answers that were of any value, so I at this time would like to offer in evidence Plaintiff's Interrogatories 1 to 5 only and Defendant's Answers, and I would like to read them into the record, if it is agreeable.
The Court: You may do so.

Mr. Greer: Are you giving them an exhibit number?

75 Mr. Rathburn: No.

Plaintiff's Interrogatory 1:

"Has defendant at any time sold and/or offered for sale a composite inoculant for alfalfa and clover identified by the trade name LEGUME-AID?"

Defendant's Answer to Interrogatory 1:

"For answer to interrogatory numbered 1, the Defendant states that it does not understand specifically from this interrogatory what is meant by the term 'a compositive inoculant', but states that it has sold a combination inoculant for alfalfa and clover and that is identified by the trade name of LEGUME-AID."

And Plaintiff's Interrogatory 2:

"If the answer to Interrogatory No. 1 is in the affirmative, were any of such sales made within the Southern Division of the Southern Judicial District of Illinois?"

Defendant's Answer to Interrogatory 2:

"For answer to interrogatory numbered 2, the Defendant states that the sales referred to in answer to interrogatory numbered 1 were 'made within the

76 Southern Division of the Southern Judicial District of the State of Illinois.'"

Plaintiff's Interrogatory 3:

"If the answer to Interrogatory No. 1 is in the affirmative, were any such sales made subsequent to May 14, 1940, and prior to the filing of the Complaint herein?"

Defendant's Answer to Interrogatory 3:

"For answer to interrogatory numbered 3, the Defendant states that the sales referred to in the answers to interrogatories numbered 1 and 2 were made subsequent to May 14, 1940 and prior to the filing of the complaint herein."

Plaintiff's Interrogatory 4:

"Was the composite LEGUME-AID specified in Interrogatory No. 1 obtained by defendant from Agricultural Laboratories, Inc., of Columbus, Ohio?"

Defendant's Answer to Interrogatory 4:

"For answer to interrogatory numbered 4, the defendant states that the combination inoculant for
77 alfalfa and clover referred to in the 'answer to interrogatory numbered 1 was obtained by the Defendant from Agricultural Laboratories, Inc. of Columbus, Ohio'."

Plaintiff's Interrogatory 5:

"If the answer to Interrogatory No. 4 is in the affirmative, has Agricultural Laboratories, Inc. assumed, and is Agricultural Laboratories, Inc. exercising control and direction of the defense to this action?"

Defendant's Answer to Interrogatory 5:

"The answer to interrogatory numbered 5 is 'yes'."

That is the end of the Interrogatories, Your Honor. We also served on defendant approximately 80, I think it was, Requests for Admissions. We got satisfactory answers to only some of them, and I would like to read into the record those requests and answers. In many cases, the defendant answered the Request and then coupled with it a self-serving statement or qualification. I only propose to read the part that is in answer, because the self-serving statement
78 has no place in the record.

Mr. Greer: Well now, on that, Your Honor, we object to just a partial introduction of the Requests for Admissions. If he is going to introduce any of it, I think the whole of the requests and the responses to them should be in the record.

The Court: I will pass on that. I would have to pass on that piecemeal as they are read. It is entirely conceivable that the defendant might add something to it that wouldn't be admissible at all.

Mr. Rathburn: We are offering these only as admissions, Your Honor.

The Court: Yes.

Mr. Rathburn: And if the Court prefers, I will read the whole answer and then move to strike the last part.

The Court: Yes. That will give me what it is, anyway.

Mr. Rathburn: Yes.

The first Request for Admission under Rule 36:

"Plaintiff, Kalo Inoculant Company, requests defendant, Funk Brothers Seed Company, to admit,
79 for purposes of this action only and subject to all objections to admissibility which may be interposed at the trial, that each of the following statements is true:

Legume inoculants are living cultures of root nodule bacteria which in ordinary use are applied to legume seeds prior to planting."

Defendant's Response to Request 1:

"The Defendant admits that legume inoculants are living cultures of root nodule bacteria which are applied sometimes to legume seeds prior to planting but this admission is qualified by the statement that the legume inoculants may be applied to the soil as well as to the seeds."

81 Request No. 2:

"Root nodule bacteria, applied to the seeds of leguminous plants prior to planting, infect the roots of the plants and cause nodules to be formed on the roots."

Defendant's Response to Request No. 2:

"Broadly speaking, the answer to request No. 2 is 'Yes' though the word 'invade' is strictly speaking more accurate than the word 'infect'."

82 Mr. Rathburn: Request No. 3:

"Leguminous plants, when infected by root nodule bacteria effective with respect to nitrogen fixation, are capable of assimilating or fixing nitrogen taken from the air."

Defendant's Response:

"Leguminous plants when 'infected' or invaded by root nodule bacteria effective with respect to nitro-

gen fixation, are capable of assimilating or fixing nitrogen taken from the air."

83 Mr. Rathburn: Request No. 4:

"Unless root nodules are formed on the roots, leguminous plants are unable to use or fix nitrogen from the air."

The Court: Used or fixed?

Mr. Rathburn: Used or fixed.

The Court: Are those words synonymous?

84 Mr. Rathburn: They are synonymous.

The Court: All right.

Mr. Rathburn: Defendant's Response 4:

"It is a generally accepted fact that unless root nodules are formed on the roots leguminous plants are unable to use or fix nitrogen from the air or soil."

Request No. 5:

"Root nodule bacteria capable of infecting the roots of leguminous plants are of the genus known as Rhizobium."

Defendant's Response 5:

"Root nodule bacteria capable of invading or 'infecting' the roots of leguminous plants have recently been known as Rhizobium but were formerly called or known as bacillus radicicola."

Request No. 6:

"When plowed under, inoculated legume plants, which have assimilated nitrogen taken from the air,

85 enrich the soil by increasing its nitrogen content."

Defendant's Response 6:

"When plowed under inoculated legume plants which have assimilated nitrogen taken from the air enrich the soil by increasing its nitrogen content when the soil is properly supplied with mineral elements."

Mr. Rathburn: Request No. 18:

"Accepted scientific opinion is that the size and number of the root nodules formed on the roots of a leguminous plant do not measure the quantity of nitrogen fixed from the air."

Defendant's Response to Request No. 18:

"The size and number of the root nodules formed
86 on the roots of leguminous plants cannot be considered a measure of the amount of nitrogen fixed. The extent or degree of nodulation may give some indication of nitrogen fixation but is not a quantitative value."

Request No. 19:

"The efficiency of any strain of root nodule bacteria is measured by the extent of its benefit to the host plant."

Response No. 19:

"The efficiency of any strain of root nodule bacteria is measured by the extent of its benefit to the host plant."

87 Mr. Rathburn: Request No. 20:

"The extent of benefit to a host plant caused by a strain of root nodule bacteria, is evidenced by the
88 amount of nitrogen fixed in the plant."

Response No. 20:

"The correct statement should be that the extent of benefit to a host plant caused by a strain of root nodule bacteria is evidenced by the amount of atmospheric nitrogen fixed in the plant."

"The total amount of nitrogen fixation may to some extent come about from the nitrogen absorbed from the soil by the plant in addition to the amount caused by the strain of root nodule bacteria."

89 Request Number 21: The amount of nitrogen fixed in plants inoculated by certain bacteria can be determined only by chemical analysis of the plants.

Response Number 21: The amount of nitrogen fixed in plants inoculated by certain bacteria can be determined only by chemical analysis of the plants.

Mr. Rathburn: Request Number 22: Cultures of a single species of root nodule bacteria for field legumes, which cultures are classified as excellent in regard to their nitrogen fixing ability, are manufactured in several commercial laboratories and distributed through regular seed trade channels at a reasonable cost to the customer.

Response Number 22: The statement as to Request
90 No. 22 is correct.

Mr. Rathburn: Request Number 24: Prior to August 24, 1938, the filing date of the application for the Bond patent, No. 2,200,532, in suit, defendant did not offer for sale and Agricultural Laboratories, Inc., of Columbus, Ohio, did not manufacture and sell any inoculant for either the red clover or the alfalfa cross-inoculation groups, other than single culture inoculants, i.e., inoculants containing strains of root nodule bacteria of only one species.

Response Number 24: Prior to August 24, 1938 the Agricultural Laboratories, Inc. of Columbus, Ohio did not manufacture and sell and the Defendant did not
91 offer for sale any inoculant for either the red clover or the alfalfa so called cross-inoculation groups other than single culture inoculants i.e., inoculants containing root nodule bacteria for more than one of these plants.

Request Number 25: The Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, obtained from Agricultural Laboratories, Inc., and sold by defendant, contains two species of root nodule bacteria.

Response to Number 25: For response to request No. 25 the Defendant states that the Legume-Aid inoculant combination for alfalfa and clover groups obtained from the Agricultural Laboratories, Inc. and sold by the Defendant contains two strains of root nodule bacteria.

Request Number 26: One of the species of root nodule bacteria contained in the Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, sold by defendant is the species known as Rhizobium trifolii.

Response Number 26: One of the strains or varieties of root nodule bacteria contained in the Legume-Aid inoculant sold by the Defendant is that which some scientists describe and call Rhizobium trifolii.

92 Mr. Rathburn: Request No. 27: One of the species of root nodule bacteria contained in the Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, sold by defendant is the species known as Rhizobium meliloti.

Response to Number 27: One of the strains or varieties of root nodule bacteria contained in the Legume-Aid inoculant sold by the Defendant is that which some scientists designate and call Rhizobium meliloti.

Request No. 28: The root nodule bacteria in the Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, sold by defendant are contained in a base including humus.

Response to Number 28: The root nodule bacteria in the Legume-Aid inoculant sold by the Defendant are contained in a base including humus.

Request Number 29: The root nodule bacteria in the Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, sold by defendant are contained in a moist powder base.

Response to Number 29: The root nodule bacteria
93 in the Legume-Aid inoculants sold by the Defendant are contained in a moist powder base.

Request Number 34: The Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, sold by defendant is as efficient in respect to its ability to fix nitrogen in red or crimson or mammoth clover plants as a single culture containing the same strains of Rhizobium trifolii as are contained in the said combination Legume-Aid.

Response to Number 34: The Legume-Aid inoculant sold by Defendant is as efficient in respect to its ability to fix nitrogen in red or crimson or mammoth clover plants as a single culture containing the same strains of clover bacteria (Rhizobium trifolii) as are contained in the Legume-Aid for alfalfa and clover.

95 Request Number 35: The Legume-Aid Inoculant, Combination for Alfalfa and Clover Groups, sold by defendant is as efficient with respect to its ability to fix nitrogen in alfalfa or sweet clover plants as a single culture containing the same strains of Rhizobium meliloti as are contained in said combination Legume-Aid.

Response to Number 35: The Legume-Aid inocu-
96 lant sold by Defendant is as efficient in respect to its ability to fix nitrogen in alfalfa or sweet clover plants as a single culture containing the same strains of alfalfa bacteria (Rhizobium meliloti) as are contained in the Legume-Aid for alfalfa and clover groups.

VARLEY SHERMAN BOND called as a witness hereby by the plaintiff, being first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Thiess.

Q. Will you please state your full name, your residence, and present occupation?

A. My name is Varley Sherman Bond; 1628 York Street, Quincy, Illinois.

Q. And your present occupation?

97 A. My present occupation is Chief Bacteriologist of the Kalo Inoculant Company, Quincy, Illinois.

Q. Now, will you please state, Mr. Bond, the training and experience that you have had which would qualify you as an expert in the bacteriological line, particularly with respect to bacteria for use as cultures for plants?

A. I received my Bachelor of Science degree from the University of Wisconsin, and my Master of Science degree from the same institution. The Master of Science degree was granted in the Department of Agriculture; well, it was from the Department of Agricultural Bacteriology.

In addition to that, I spent 2 1/2 years as Research Assistant in the laboratory at the University of Wisconsin, investigating the biological chemistry of this same particular nitrogen fixation problem.

After leaving school I have had nine years' experience in the commercial field of legume inoculants with the Kalo Inoculant Company, here in Quincy.

Q. Now in this graduate work you used the broad expression there,—did you, for my benefit and for the benefit of his Honor,—did you do any work particularly in the field of legume bacteria?

A. All of the work was devoted to this particular
98 field of legume bacteria and its relation to the legume plants.

Q. (By Mr. Thiess) Under whose direction was that?

A. That was directly under Dr. P. W. Wilson and indirectly under Dr. Baldwin and Dr. Fred, both of whom are well-recognized authorities in this field.

Q. Dr. Fred; is that the man that was president of the University of Wisconsin later on?

A. Dr. Fred is now president of the University of Wisconsin.

Q. Now, what generally was the character of work that you did in the laboratory of the Kalo Inoculant Company?

A. I was in charge of the commercial production of the legume cultures and also was in charge of research to improve and maintain the quality of the product.

Q. And you are the Varley Sherman Bond who is the patentee named in the U.S. Patent 2,200,532, here in suit?

A. I am.

Q. Now, Mr. Bond, will you please tell us what leguminous plants are?

99 A. Leguminous plants are plants that commonly bear their seeds in pods such as peas or beans, alfalfa, clover; and there are several others in this family of plants.

Q. Are there any other features that are characteristic to the leguminous plants besides this podding feature, as you call it?

A. Legume plants are also characterized by their ability to fix atmospheric nitrogen, when nodules are present on their roots.

Q. Now, will you please explain what these nodules are that are fixed to the roots, and have you got a plant here that you want to show us?

A. Yes.

The Court: You are saying nodules that are fixed to the roots?

The Witness: Nodules that are on the roots; that are part of the root.

The Court: You used the term "fixed" in an entirely different way.

The Witness: Did I say "fix"?

The Court: You said something about fixing the nitrogen.

The Witness: Yes; by "fix" we mean the nitrogen
100 of air which is unavailable to plants as such; it is very inert. It is a gas. 80% of the air in the room is nitrogen, but somehow or other these bacteria in the nodules, in combination with the plant, are able to convert that nitrogen so that the plant may use it.

It is the same thing as applying a nitrogen fertilizer, such as nitrates, to the plant.

The Court: That is what you mean when you use the term "fix"?

The Witness: By "fix" we mean the taking out of the

air of atmospheric nitrogen and putting it in a form that the plant can use it.

The Court: The plant's ability to do that depends on these nodules on the roots?

The Witness: If the nodules are not present on the roots no fixation takes place.

The Court: All right.

Q. (By Mr. Thiess) Now, will you just explain those nodules to his Honor and illustrate what you have in those two pots.

A. These pots were just taken from an experiment we had in the greenhouse. This pot (indicating) was inoculated with strains of soybean bacteria and you can
101 see the nodules that formed on these roots, these little lumps or nodes which cover the root tissues (indicating).

The majority of these are near the top or so-called tap root. And the difference between this group of plants and this group here (indicating), in which no nodules are present, or, if there are, there may be a few little ones scattered around, coming as a result of contamination,—but the difference between these two plants is solely due to bacteria on the roots.

These had inoculation added to them (indicating one pot) and these did not (indicating the other pot), and the difference between the two pots is solely due to the bacteria.

The Court: The same length of growth, etc.?

The Witness: They were started at the same time and grown under identical conditions.

Q. (By Mr. Thiess) And grown in sterile sand, are they not?

A. Yes.

The Court: Grown under the same conditions so that they would be comparable?

The Witness: That is right; to measure what effect these bacteria have. We grow the plants just as
102 closely as we can, under identical conditions, and the difference between the plants is measured specifically by chemical analysis and treatment, which we will later explain.

Q. (By Mr. Thiess) Now, is there any well-known scientific information with respect to how these nodules are formed? Is it due to an infection of the roots?

A. Yes, the bacteria from the cultures enter the roots

of the plant and cause a swelling or enlargement of the root tissues and it results in the nodules that we just demonstrated, on the roots of these plants.

Q. And are nodules of this character exclusive to leguminous plants?

A. Nodules of this character are exclusive to leguminous plants.

Q. Now, how do other plants, such as grains and grasses, get the necessary nitrogen for their development?

A. Grains and grasses can only obtain nitrogen for their development from the mineral forms of nitrogen contained in the soil or possibly organic forms of nitrogen, too, that are in the soil.

They are the only sources of nitrogen to the non-leguminous plants.

The Court: I want to be clear about that. They
103 get their ability to absorb nitrogen from what is in the soil—

The Witness: No; all plants have a certain percentage of nitrogen in them, contained as proteins, whether it is corn, wheat, soybeans, alfalfa, or whatever plants you may select.

The protein in the plant contains nitrogen as a chemical element and that chemical element had to come from somewhere. In the case of corn and the non-leguminous plants, and wheat, it comes from the nitrogen already contained in the soil,—the fixed nitrogen in the soil.

Legumes can also take fixed nitrogen from the soil but with the presence of legume bacteria on the roots in nodules, they can also take atmospheric nitrogen out of the air. It is a very unusual quality of leguminous plants.

Q. (By Mr. Thiess) Now, to what extent are these nodules of these leguminous plants beneficial to the plant itself and to the soil?

A. The nodules benefit the plant in this way: The combination of bacteria and the plant, and the nodule somehow or other is able to fix this atmospheric nitrogen, and it results in an increased yield to the plant and it also increases the protein content of the plant.

104 If this plant is, in turn, plowed under and allowed to decompose in the soil it has the same effect as though you had added mineral fertilizers to the soil,—nitrogen fertilizers.

Q. (By Mr. Thiess) What do you mean when you say you inoculate a legume?

A. An inoculated legume is one the roots of which are infected with a legume bacteria, and the evidence of which is shown in the form of nodules.

Q. And where do these bacteria come from?

A. The bacteria are present in the soil to a certain extent. Some soils are well-established with these legume bacteria and others do not have them present at all.

Q. And why is it advantageous to inoculate seeds of legume plants with this bacteria if they are found in the soil?

A. Well, if the bacteria are already in the soil, the odds are that they are of an inefficient strain, or they may not be of the correct cross-inoculation culture.

For example, a soil containing soybean organisms would in no way benefit clover plants, if they have been planted in that soil.

105 Q. To what extent, if any, are inoculated legume crops advantageous from the standpoint of crop rotation?

A. It is a well-known precept of agriculture, that the rotation of legume crops with non-leguminous, benefits the non-leguminous crop as well as the leguminous crop.

If the leguminous crop is plowed into the soil, the nitrogen fixed from the air is available to the succeeding crop and therefore increases its yield.

Q. To what extent are the bacteria of the genus Rhizobium found in the soil?

A. Well, the bacteria are found in some soils and are not found in others. They are not universally present in the soil.

The Court: You say if the leguminous plants are plowed up and rotated by the non-leguminous, it would be advantageous to the non-leguminous also?

The Witness: That is true.

The Court: But these bacteria that you infect the leguminous plants with, have no effect on the non-leguminous?

The Witness: They have no effect. The benefit is due to the addition of the nitrogen to the soil. It is equivalent to adding nitrogen fertilizer to the soil. The soil 106 is enriched with respect to its nitrogen content.

The Court: It is not the effect on the plant itself but what the plant has done to the soil?

The Witness: If the plant is plowed under and decom-

poses. If the crop is removed from the soil, the benefit to the soil is very small, if any.

However, at the same time the soil would be indirectly benefited, because it has not withdrawn nitrogen out of the soil. It has left whatever is in there so that the following crop is going to have more nitrogen.

Q. (By Mr. Thiess) What is meant by the term thorough inoculation as used in this art?

A. Thorough inoculation is inoculation of the roots of leguminous plants in such a manner that an ample supply of nodules are formed on these roots.

Q. And in the event that the bacterial content of the soil is not sufficient to form the desired number of nodules, what has been the practice with regard to providing the proper number of bacteria for this purpose?

A. There is no way to tell how many of the legume organisms may be in the soil, and it is now a common practice to apply cultures of legume bacteria to the seeds prior to planting, in order to insure each seed,—each
107 root that develops from these seeds,—in order to insure the bacteria on the roots of these plants, so that the nodules can be formed and the plant can benefit from it.

Q. What do you mean by the term artificial cultures, as used in this art?

A. Artificial cultures are cultures prepared in a laboratory and sold through regular seed trade channels to the farmer who, in turn, applies them to the seeds of his leguminous plants.

Q. Will you now please explain rather fully how these bacteria Rhizobium are divided into species?

A. Well, it is known that the legume—

The Court: Tell me first what the bacteria Rhizobia is; tell me what Rhizobia means.

The Witness: Rhizobia is the plural of the genus terminology that is used in bacteriology. The genus name for this group of legume bacteria is Rhizobium; the plural of Rhizobium is Rhizobia, and clearly referring to the bacteriological classification of root nodule bacteria.

A. (continued) The root nodule organism isolated
108 from one plant, such as clover, normally does not form nodules on plants such as alfalfa and soybeans, peas or beans.

Likewise, the organisms isolated from alfalfa will not form nodules on clover. However, it has been found

that the organisms isolated, say, from red clover will also inoculate crimson clover and mammoth clover and Alsike clover,—that whole group of clover plants which is called a cross-inoculation group because bacteria isolated from the nodules of any one of them will form nodules on any of the others.

Q. (By Mr. Thiess) Now, will you please identify the species of the well-recognized cross-inoculation groups as known in this art?

A. There are six well-known species in the art. Rhizobium trifolii will form nodules again on red clover, crimson clover, Alsike clover, and certain others of the clovers.

Rhizobium meliloti will form nodules on alfalfa as well as white and yellow sweet clovers. Rhizobium phaseoli will form nodules on garden beans. Rhizobium leguminosarum will form nodules on peas; Rhizobium lupini will form nodules on lupins, and Rhizobium japonicum is capable of forming nodules on soybean plants.

109 Those are the principal groups.

Q. Now there are other species of Rhizobium which exist in the soil, are there?

A. There are other groups of organisms which have not been specifically defined, due to the fact that their reciprocal inoculation of different species is not uniform. That is, at times an organism, isolated from other plants, will form nodules on another, but the bacteria from the second plant will not form nodules on the first.

It is a non-reciprocal inoculation. That is the reason that these additional groups have not been assigned a specific terminology, and the reason that we say they are not well-defined.

Q. Well, briefly stated, the six groups are the ones that are really used commercially?

A. The six groups are the ones used most, commercially; outside of this specific terminology there are the cowpeas organism and lespedases and a few others. The principal groups, commercially important to the farmer, and to the commercial inoculant manufacturer, are alfalfa, clover, soybeans,—the six groups.

110 Q. Now, what do you mean in this art when you speak of a pure culture?

A. A pure culture is one that contains a single strain of the organisms; that is, there are no other contaminating bacteria present, or no other bacteria, even of the

legume bacteria, present, other than that one species or one strain of a species.

Q. Now, I would like to have you explain how the pure cultures of the various species are obtained, and in this connection I am going to hand you a drawing which was made under your supervision, and which I will ask the Notary to mark for identification as Plaintiff's Exhibit 3, which you can use in making this explanation.

(Said chart, headed "Source of Stock Strains", was thereupon marked as Plaintiff's Exhibit 3 for identification.)

A. This first chart illustrates the source of stock strains of bacteria that are subsequently used in manufacturing commercial inoculants. Figure 1 is a pic-
111 ture of a clover plant that is taken from the field. On the roots of this plant are found the nodules identified at 2.

Q. Nodules like the ones you show on the growing plants?

A. Nodules like the ones shown on the soy bean plants. The nodule is picked from the plant, a large view of which is shown in 3, and by means of bacteriological isolation, according to technique known to the art, as shown in Box 4, the bacteria are transferred to a jelly slant, illustrated at 5. This slant is a test tube with a cotton stopper at the top and jelly at the base, and on the surface of this jelly the bacteria are grown.

The Witness: That is all right, I think the diagram is clear enough. The bacteria in this test tube are subsequently tested by means of laboratory tests to ascertain whether the culture of bacteria is pure; also by nodulation tests to make sure that these bacteria are from the red clover group. And this is followed by
112 efficiency tests for nitrogen fixation to determine how beneficial this particular stock test tube culture may be when used in a commercial product.

Mr. Thiess: Q. Now, the test tube contains the slant. Can you just go into that a little more fully and state what you have got in that test tube and what happens in that test tube?

A. Well, the test tube—the jelly at the base of the test tube contains food materials on which these bacteria grow.

Q. That is the nutrient we were talking about earlier in this case?

A. That is the nutrient we were talking about, that is correct. And the bacteria are transferred to this tube by standard bacteriological methods, and subsequently the tube is incubated or stored in a slightly elevated temperature for anywhere from two or three days to a week, to permit the bacteria to multiply and grow on the surface of this jelly.

Q. And the bacteria from Box 4, where you say "Bacteriological Isolation", is transferred to the tube manually, or just how do you do that?

A. Well, it is—do you want me to describe the procedure of isolating the organism from a nodulation?

113 Q. I don't believe it is necessary to go into all that.

A. It is transferred by means of a loop. That is a standard piece of apparatus in bacteriological isolation.

Q. And the bacteria that are developed on this slant are a larger number, are they?

A. Yes, a larger number of organisms. It runs into the millions that are developed on a single slant.

Q. Now, will you explain just a little bit more what you mean by laboratory tests for purity?

A. Well, laboratory tests for purity are again standard bacteriological tests, in that slides are made of the bacteria and they are examined under the microscope to see if—it is typical staining reactions, and also if they are of the proper size and shape. In addition to that biochemical tests are run in test tubes to determine whether contaminating organisms are present or not. It is again a standard bacteriological procedure familiar to the art.

Q. And to what extent is this purity essential?

A. Well, frequently in isolating the bacteria from the nodule, 3, contaminating organisms are also intro-

114 duced into the stock test tube slant, and to insure that this is a pure culture of the particular organisms isolated these purity tests are conducted.

Q. Now, will you also give the same explanation as to the nodulation tests which are referred to on the chart? Will you just generally give me an answer to that question?

A. Oh, the nodulation tests are conducted to ascertain that the organisms that are in that test tube will again form nodules on clover plants.

Q. Now, I again refer you to a drawing which was

prepared under your direction and which I will ask to have marked for identification as Plaintiff's Exhibit 4.

(Said chart, headed "Nodulation Test", was thereupon marked as Plaintiff's Exhibit 4 for identification.)

Q. Using this drawing will you explain in detail how your nodulation test is made?

A. Well, in order to test the stock strain diagrammed at 1, to determine whether it contains the proper type of bacteria to form nodules again on clover plants; we use tumblers filled with sterile sand, diagrammed in 2 115 and 3. There are two series of those tumblers run. One of them is called the uninoculated control series and the second series is called the inoculated series. The sterile sand—and tumblers 2 and 3 has sterile sand planted in it—and nitrogen, free nutrient solution, is added. The sand is sterilized and the seed is sterilized to insure the absence of any stray contaminating organisms that may have been in the sand or on the seed. To the sterile sand, and the seeds planted in tumbler 3, the bacterial suspension as diagrammed in Box 5 is added. This bacterial suspension is, in turn, obtained from our stock strain 1 by adding sterile water to it and making a suspension of the bacteria growing on the surface of the jelly slant.

Both series are treated exactly alike except the inoculated series has a bacterial suspension in box 5 added to it.

After approximately three to five weeks growth, at which time clover plants would be approximately two to four inches high—it is diagrammed in 6, or illustrated in Nos. 6 and 7—the plants are removed from the tumblers, the sand is washed from the roots, as diagrammed in Boxes 8 and 9, and the roots of plants 10 and 11 are inspected for the presence of nodules. If no nodules 116 are found on the roots of the plants, Figure 10 of the uninoculated control series, and if nodules are found on the plants, 11 of the inoculated series, that is considered a positive nodulation test. That means that the bacteria in the stock test tube strain 1 were of the species or of the group that will form nodules on these particular plants.

Q. Now, what is the purpose of having the two series of tests, one with the uninoculated series and one with the inoculated series? Just give me that again in a few words.

A. Well, the reason for using the uninoculated control series is to determine whether the nodules that are formed in the inoculated series come only from this stock test tube strain over here. They may have come from the sand, since it may not have been properly sterilized, or they may have come from the seeds, or may even have come—stray bacteria from the air may cause the formation of nodules, and the only way to check to see that the nodules that are on the plants did come from the culture is to run an uninocu-
117 lated control series at the same time. If no nodules are formed there, then the sand is sterile and there were no bacteria drawn from the air, and your seeds are sterile and you are sure again that the nodules formed on these plants came only from the stock test tubes.

Mr. Thiess: Q. If at the close of your test you found that nodules had been formed on control plant 10, what would you consider this as showing?

A. That is just what I explained.

Q. Now, in the diagram, Plaintiff's Exhibit 4, you show three to five weeks' growth between the sterile sand pots and the plants. To what extent are the plants developed in that period of time?

A. Well, normally they will develop two to four inches.

The Court: Q. Are you speaking of the test tube in terms of yield or are you speaking of inoculating the plant?

A. In this particular case the plants are not grown up for a long enough period for the bacteria to take any effect on the yield of the plant. There is another test coming up in which we discuss the efficiency
118 tests, on which the importance of our work is based.

Q. The first few weeks it does not make any difference?

A. In the first few weeks very little difference is observed. After the end of five weeks normally the inoculated series will look greener and the plants may be a little higher, but it is scarcely long enough for any real significant difference to show up.

119 The Court: Q. Does the plant produced by the inoculation, does that necessarily mean that it will produce more and better beans, or whatever the—

A. That is right, that is the fundamental purpose of inoculation, is to increase the yield of the crop to the

farmer, not only in the plant but in the beans and seed as well.

120 Mr. Thiess: Q. Now, you have referred to these efficiency tests on Plaintiff's Exhibit 3 as the last test. And what do you determine by these efficiency tests?

A. The efficiency tests determine the nitrogen fixing ability of these bacteria. Some of the bacteria will form nodules but will not benefit the plant on which they are growing. On the other hand, other organisms, or other strains of the same organism, will produce a maximum yield of the plant.

Q. Then, as I understand you, the nodulation test is no criterion of the amount of nitrogen that the plant might fix?

A. The nodulation test merely indicates the presence of the right type of organisms. It does not indicate how much benefit the plant will obtain from that organism.

121 Q. What have you to say with respect to the comparative ability of the different strains of the same group of root nodule bacteria, to benefit the host plant?

A. The strains have been roughly classified all the way from poor to good strains. A poor strain produces a very slight increase in benefit. A fair strain will produce a little more, and a good strain or excellent strain will produce the maximum amount of benefit to the plant. There is a considerable variation between these strains of bacteria, just as there are in any other biological phenomena. There is a difference in corn seeds. That is, one corn plant will produce twice as much as another. Different strains of different plants and different animals will produce differences in yields. The same thing is true of bacteria.

Q. By strains you mean strains of one particular species?

A. In respect to the nodule bacteria, yes.

Q. When you say there are differences in strains, am I correct in saying that those differences in the strains of bacteria are just the same as there are differences between individuals? No two individuals are alike,

122 is that correct?

A. That is right, some are short and some are tall.

Q. I now wish to hand you another chart which you have made, to explain the efficiency test, and which I

would like to have marked for identification as Plaintiff's Exhibit 5.

(Said chart, headed "Efficiency Test for Nitrogen Fixation", was thereupon marked as Plaintiff's Exhibit 5 for identification.)

Q. Referring to this exhibit, explain rather fully just what this efficiency test is and why it is conducted.

A. Well, this chart illustrates an efficiency test for nitrogen fixation. Going back to our stock strain 1, which was isolated and tested for nodule formation in accordance with the previous charts, we now—after having tested it bacteriologically and for nodule formation, a third test must be made for its efficiency. Sterile sand in half or one gallon pots—these are half gallon
123 pots that we have these soy beans in—is again watered with nitrogen-free nutrient solution and planted with sterile seed as diagrammed in Box 3. However, instead of permitting the plants to grow for just a short period of time, they were permitted to grow for from two to three months, even longer, until mature plants develop in these pots, as diagrammed in 5. The sand is then washed from the roots, as indicated in Box 6, and the plants are subsequently dried as indicated in 7. These dried plants are then weighed as shown in Box 8, and a sample of these dried plants is removed—that is, the dried plants are first ground and a sample is removed to determine the amount of nitrogen that is contained in the dried plants.

This is done by a standard chemical procedure which is called the Kjeldahl nitrogen analysis, as diagrammed in Box 9. The dry weight of the plants as obtained from the measurement in 8 times the percentage nitrogen determined in accordance with the Kjeldahl analysis gives us the total nitrogen that is contained in the inoculated plants.

At the same time and under identical conditions a second series of uninoculated control is also run.
124 These are treated in exactly the same way, except that no bacteria are added to them. This is comparable to the uninoculated series diagrammed in the previous chart on nodulation; that is, it is started in the same manner but again the dry weight of the uninoculated controls is measured and the percentage of nitrogen is measured and the total nitrogen of the uninoculated controls is determined.

Now, the efficiency of stock strain 1 is the amount of nitrogen fixed by that strain, and is equivalent to the total nitrogen of the inoculated series minus the total nitrogen of the uninoculated control series.

Q. Have you finished?

A. Yes.

Q. Now, why do you subtract the total nitrogen control from the total nitrogen inoculated to get your nitrogen fixed, that is, the efficiency?

A. Well, the difference in the nitrogen in the inoculated plants and the nitrogen in the control plants is due to the atmospheric nitrogen fixed from the air by the bacteria which were obtained from this stock test tube 1. Now, there is a small amount of nitrogen in the seeds of the plants, and also possibly in the
125 sand, and this nitrogen is found in the uninoculated control series. The inoculated series likewise have this same nitrogen in them. Therefore, the difference between the control series and the inoculated series gives us the result of the efficiency of these bacteria, tells us how good they are.

Q. Now, what is the general purpose of running one of these efficiency tests?

A. Well, the efficiency test is to determine how good the bacteria—and is diagrammed again here in 1,—how good these bacteria that have been isolated will be in benefiting the crop to which they will be applied, and it is only by means of efficiency tests that we are able to select the highly efficient or good strains of bacteria and use them in commercial culture. There is no other way to determine how good these organisms are, how much benefit they will produce in the plant, other than by an efficiency test of this nature.

Q. This efficiency test will tell you whether your strain is fair or whether it is good or whether it is excellent, will it, then?

A. That is right.

126 Q. And having run the efficiency test and having found a strain that is excellent, for instance, do the characteristics of that strain remain with the bacteria so you can depend upon it?

A. Yes, the entire inoculant industry is based upon the stability of these strains. After having determined a strain as being efficient, it stays that way unless the strain is subjected to particular treatment. Those ef-

ficiencies can be altered by several different means, but under proper conditions the efficiency of a culture can be maintained in the laboratory over a period of—well, they have records at the University of Wisconsin that extend back over twenty years, showing constant—

Q. Consistency of strain?

A. Yes, the good strain in 1925 is still good in 1945.

Mr. Thiess: Is that clear, your Honor?

The Court: I think so, although I am just—is that how we measure competitive products, in the character of the strain?

The Witness: Yes, competitive products could be measured on that basis. However, I believe I am correct in stating that all of the companies now engaged in the

127 —that is, any company of any size engaged in the manufacture of commercial culture use only highly efficient strains, and there is probably very little difference in the efficiency of the strains, as used by the companies, but for one to come out and just take the strains and not test them, not know what they will do, and just put them in a culture, may produce some nodules on plants all right but there is no way of telling how much benefit it is going to do to the crop.

The Court: I see. But reputable concerns putting them on the market, they are all good?

The Witness: They use nothing but efficient strains in their culture.

Mr. Thiess: Q. In other words, the efficiency test has got to be made in order to be sure that you have gotten a good strain?

A. That is right.

129 Q. Mr. Bond, I now refer you to another drawing which you made which I would like to have marked for identification as Plaintiff's Exhibit 6 and, using this drawing, will you please—

Mr. Greer: Isn't that No. 5?

Mr. Thiess: (Continuing)—please state how the efficiency of these bacteria affect the ultimate growth of the plant?

(Said drawing was marked Plaintiff's Exhibit 6 for identification.)

A. These charts show the importance of the efficiency tests just described. The chart on the left-hand side is a typical efficiency test conducted in the greenhouse in pots and shows the difference between a good strain, a

fair strain and a poor strain and also shows the amount of nitrogen obtained from the uninoculated controls.

The total milligrams of nitrogen for ten clover plants is indicated by the vertical line.

Q. At the extreme left?

A. No, that is the total milligrams of nitrogen in the plants. That is the line to which the figures are attached, 25, 75, 100, and 125 milligrams.

130 The line at the far left designated by "Nitrogen Fixed" shows the amount of nitrogen that was fixed by these different strains. In other words, it is again the difference between the uninoculated plants and the amount of nitrogen found in the inoculated plants.

Now, to show what this means in terms of field results to the farmer who is using the culture, we made the diagram on the chart on the right-hand side of the page. The squares represent bales of clover hay per acre. Clover hay normally isn't put in the form of bales but it was an easy method of diagramming to show the difference. Alfalfa hay is quite frequently baled.

The uninoculated crop produced, in this particular case, produced seven bales of, say, two hundred pounds each. The good culture of inoculant containing good strains produced a total of fifteen or an increase of eight bales. The fair column only produced twelve bales or an increase of five bales. The poor column only produced an increase of two bales.

This shows the necessity of using highly efficient or good strains in a commercial product. The poor strain did better than the uninoculated control if the farmer hadn't used any inoculant. He would have obtained good results, but he wouldn't have obtained the result he could have obtained with a good culture containing a highly efficient good strain.

131 The Court: Does this show the experiment?

The Witness: This doesn't demonstrate the specific experiment. However, there are articles in scientific journals that indicate the results. These are just arbitrary, good, fair and poor strains.

Mr. Thiess: Q. And what is the economic advantage from a farmer's standpoint in using a very efficient inoculant for his red clover seeds?

A. A very efficient inoculant is going to mean dollars and cents to him. A hundred acres would really mean something so far as the net economic result of using a good

strain compared to a fair or poor one and when that is translated into all the farms using a commercial inoculant, it covers a considerable portion of the crop.

The Court: Well, the cost of inoculant, of course, is insignificant?

The Witness: The cost of inoculant is very insignificant and an inoculant is used by almost all of the better farmers. However, the principal objection to using an inoculant is less in its cost than in the trouble it takes to put it on before they plant the seeds.

The Court: Is that normal?

The Witness: It isn't in red clover but, for example, in the case of soy beans, a farmer as in the past month on account of poor weather might have wanted to get
132 those seeds in; a good day comes along and he wants to get it in.

The Court: How do you inoculate a bushel of clover seed with that? Do you have to have a machine?

The Witness: No, the bushel of seed is placed on a good floor or container and the seed is slightly moistened and stirred up and the inoculant added and again stirred into the mixture or the inoculant may be suspended in water and that suspension applied to the seed and all it requires is mixing.

The Court: It does require moisture?

The Witness: It does require moisture. The directions on the package tells you what is enough moisture to moisten the seed or properly distribute the organisms. The idea is to get this culture spread all over the seed.

The Court: So, every seed, as near as possible, will have some of this?

The Witness: Yes.

Mr. Thiess: Q. You can see it on the seed?

A. The humus or black material is very evident on the seed after it has been inoculated.

The Court: The seed would have to be thoroughly dry?

The Witness: Not enough water is added to appreciably moisten the seed; it is just slightly. It may take a little time for the moisture to dry to handle it properly but there isn't enough moisture there to seriously impede
133 the farmer in planting his seed but he does have to stir it into his seed and one hundred acres of soy beans may take anywhere from one hundred to two hundred

bushels of seed and unless he has a mechanical contrivance, it amounts to a considerable amount of work. Some, of course, inoculate it in the drill box of the planting drill.

Mr. Thiess: Q. Now, prior to the date you made this discovery or invention as disclosed in this patent, was there any commercial practice for inoculating seeds of leguminous plants?

A. Yes, commercial inoculants have been sold for many years, particularly in the single cultures. For years commercial inoculants, prior to application for the patent, were sold as single cultures; that is, there was one culture for clover, one culture for alfalfa and one culture for soy beans and there are still products on the market that are confined to the single culture type.

Mr. Thiess: Q. Now, will you please explain how a stock strain is prepared in accordance—well, put it this way—a stock strain is prepared, using one of your drawings here, for commercial use? Can you use one of your drawings to show that?

This is a drawing which you prepared and I ask that it be marked for identification as Plaintiff's Exhibit 7.

(Said chart headed "Preparation of Humus Type Culture" was thereupon marked as Plaintiff's Exhibit 7 for identification.)

134 Now, when you explain that, go into that rather fully, will you, Mr. Bond?

A. This chart illustrates the preparation of a humus type culture in accordance with the specification of the patent.

Starting with the test tube stock strain 1 which was isolated and tested in accordance with the previous charts, this is transferred to a larger bottle 2, in this case a six ounce bottle slant and the base of the bottle contains this jelly food material for the bacteria. The bacteria grow on the surface of the jelly. The bottle in this case is closed with a cotton stopper to exclude the entrance of contaminating bacteria.

After the bacteria has grown in this bottle for a period of two or three days, a suspension is made by adding sterile water and is transferred aseptically to a sterile atomizer and the bacterial suspension atomized into a plurality of 32 ounce bottle slants illustrated in 3.

These bottles, again, have the jelly food material at the bottom and the bacteria grow on the surface of the jelly. These bottles are incubated for two to ten days and during that period of time a heavy growth of bacteria develops on the surface of this jelly food material.

After this incubation period, due to the fact that the organisms have grown up in large numbers in these
135 bottles and that the entrance of an occasional contaminant at this stage would not substantially affect the bacteria that are subsequently going to be in the finished product, there is a dotted line indicating the sterile conditions; that is, beyond that line it isn't necessary to maintain sterile conditions.

These bottles have water added to them as diagramed in 4 and the jelly is broken up in the water by means of a probe.

This suspension was further incubated from twelve to thirty-six hours to get an additional growth in this water that was added to the bottles. After this incubation period, which is usually over-night or to the following day, the coarse part of the jelly is separated by Filter 5 into a container 6.

This container then contains the bacterial suspension, a milky looking liquid containing the leguminous organisms. This suspension is added to a mixer containing humus and a measured amount of water as diagramed in block 7.

The mixer, as shown in 8, mixes the humus or the inert base and the bacterial suspension and, after the mixture is thoroughly stirred, it is discharged into a drum diagramed in 9 and this finished culture is stored for approximately twelve hours to permit the absorption of the moisture contained in the suspension into the humus. It changes the physical characteristics of the humus by storing it overnight.

136 This finished culture is packaged by automatic packaging machines and we have the finished product. I have some samples somewhere.

The Court: Is it in powder form?

The Witness: I have some here I will show you. The finished product is a powder but it is a moist powder, it isn't dry.

Here is the can. That is the same size container as the one you see in the box. That will inoculate a bushel of

seed. That particular culture is made for soy beans and clover and alfalfa. It will inoculate all three. The finished product—it looks dry. That has approximately thirty-eight per cent moisture in it. It looks dry.

The Court: But it isn't as dry as this package?

Mr. Thiess: That is a dead package.

The Witness: That is not a fair comparison. The packages are dated. These are some samples without dates but here is dates here. Beyond that period the package cannot be used.

Mr. Thiess: We have had that package in our office for a number of years before the suit was tried.

The Court: Most of these products are valuable only for a limited time?

Mr. Thiess: For a limited time.

The Witness: This package is not a finished product. This is the humus itself. I called up and told them to
137. send down some material. The finished product is moist.

The Court: The ordinary person would not know the difference?

The Witness: No. You can not tell by looking at it whether it has any bacteria in it or not. As a matter of fact, the only way you can tell if there is leguminous material in it is to add it to plants.

Mr. Greer: May I interrupt? This also has an expiration date on it just the same as the LEGUME-AID?

The Witness: Yes.

Mr. Thiess: I thought the Judge was interested in that.

The Witness: All the products have an expiration date. The reason for the expiration date is because the product deteriorates. The bacteria is a living organism and, naturally, won't live forever. It has a date on it and, after that, the package should not be offered for sale.

Mr. Thiess: You see, if it is dry, it just drops out of there. (Indicating)

The Court: You have your bacteria dated just the same as coffee?

The Witness: That is right.

Mr. Thiess: I would like to offer these two cans in evidence. I would like to offer the can that has humus in it—

The Witness: That is just humus.

Mr. Thiess: (Continuing)—just humus, not culture,
138 as Plaintiff's Exhibit 8 and I offer the other can that has the three-in-one culture for clover, alfalfa and soy beans as Plaintiff's Exhibit 9.

That is correct for the second can?

The Witness: Yes, that is correct.

(Said cans, so offered, were received in evidence by the Court, and marked respectively Plaintiff's Exhibits 8 and 9.)

Mr. Thiess: This Uni-Culture is the trade mark of the Kalo Inoculant Company for their inoculant.

Mr. Thiess: Q. Now, referring again to Exhibit 7 you have just given the explanation of, will you please state what, if anything, in the way of checking for purity and bacterial number occurs in container 6?

A. Before adding bacterial suspension—

Q. Just a minute.

A. Excuse me.

Q. All right, go ahead.

A. Before adding the bacterial suspension 6 to the mixer 8, samples are taken of the suspension and checked in the laboratory for purity and number of organisms.

139 Q. That is a rather important element of this test or this manufacture?

A. That is a check of the production of the culture.

Q. Now, Mr. Bond, will you kindly state generally the facts and circumstances which led up to the discovery of the invention described in your patent here in suit?

A. Well, in June 1937, Mr. Lusk, President of the Kalo Inoculant Company, discussed with me the possibility of the manufacture of a practical composite or mixed leguminous culture.

I was familiar with the adverse opinion of the authorities in the field in regard to mixed cultures and later that summer, while attending summer school at the University of Wisconsin, I had the opportunity of investigating the literature there in the library of the College of Agriculture and in that investigation I found several adverse references to the use of composite cultures or mixed cultures containing more than one species of leguminous organisms.

In addition to that, there were references in the literature that showed when two or more species of these differ-

ent species were mixed together, they had a definite antagonistic effect which reduced their ability to benefit the host plant. I found nothing to indicate this inhibition did not exist.

Q. Referring to this literature which you studied
140 at the University of Wisconsin which indicated that mixed cultures would not give the same results as single cultures, will you please explain a little more fully what this literature showed that gave you this opinion that mixed cultures would not function as well as single cultures?

A. Well, the literature that attempted to explain why mixed cultures were unsatisfactory indicated that an inhibition or antagonistic effect existed when two or more of the species were mixed together. In other words, a culture that would be very good when used alone, would be very beneficial, would be a highly efficient strain, when mixed with other strains would become less efficient and produce a lower yield than the same strain when used alone.

Q. Now, will you explain a little more fully what you mean by antagonistic or inhibitive effects of one species of bacteria on the other? Do you want to refer to one of these charts in doing that or would you rather do it without a chart?

A. Well, the chart illustrates it very well.

Q. All right, which chart do you want?

A. Well, the "Effect of Inhibition", I believe, is the title of it.

Mr. Thiess: Have you got it? Oh, yes. I would like to have this chart marked for identification as Plaintiff's Exhibit 10.

141 (Said chart entitled Effect of Inhibition in Mixed Culture was marked as Plaintiff's Exhibit 10 for identification.)

Mr. Thiess: Q. Now, using that chart, will you explain a little more fully what you mean by this inhibition?

A. This chart illustrates the effect of inhibition in mixed culture. Figure 1 at the upper left-hand corner shows the effect of using in the greenhouse, that is, the typical results obtained in greenhouse tests with an inhibited strain of bacteria. The uninoculated control contained a small amount of nitrogen.

This inhibited strain, or a strain which was capable of being inhibited, fixed or, when analyzed, contained the total amount of nitrogen shown by the column marked "Single".

However, when this same strain of bacteria was mixed with other strains or other species, a reduction was observed in the total nitrogen found in the plants. That reduction is the loss due to the inhibition. That is the inhibitive effect of the other strains that were contained in the mixture on this one which is indicated here as "Single". It is the same effect as changing a good strain to a poor one.

Figure 2—I am getting ahead of myself on this chart—Figure 2 shows what you would get with a non-inhibited strain of bacteria, existence of which wasn't even
142 known prior to tests we conducted in mixed cultures.

Q. There you met no loss?

A. There there is no loss. The good strain stayed a good strain.

Q. Now, will you explain Figures 3 and 4?

The Court: I don't quite understand the difference between inhibited strain and non-inhibited strain.

Mr. Thiess: Will you explain that?

The Court: The first figure there shows what happened when you mixed the two together and there was a loss due to inhibition?

The Witness: Going through the column, the uninoculated column had no bacteria added to it.

Mr. Thiess: That is column 1?

The Witness: The column marked "Single" had only one strain of bacteria in it; that is, the plant was inoculated with only one strain.

The column marked "Mixed" had this same strain, the same strain as the one marked "Single" mixed with others.

The Court: Yes.

The Witness: Due to the presence of the other bacteria, the "Single" changed from a good strain to a poor one.

The Court: The reaction between the two kinds of bacteria?

The Witness: That is right. The bacteria in asso-
143 ciation with each other reduced the yield.

The Court: Yes, I understand that. Now, over in

Figure No. 2 that didn't happen. Tell me why it didn't happen.

The Witness: Figure No. 2 did not happen because that was selected non-inhibited strains of bacteria.

Mr. Thiess: Q. Will you explain that?

A. A non-inhibited strain is a strain that when tested together with other strains does not produce inhibition.

The Court: One does not affect the other, is that right? One strain does not affect the other?

The Witness: That is right.

Mr. Thiess: Q. Will you just explain now what you did and how you found these non-inhibited strains and the tests you made?

A. Well, the following year, in the spring of the following year, cultures that were prepared from mixtures of different strains were tested in our laboratory or our greenhouse to determine just what effect mixing of these strains would have upon each other and in those tests we observed not only inhibition which was indicated in the literature but we also observed that some strains did not show this inhibition. They did not, apparently, affect each other and, from that, the logical conclusion was that strains could be selected, if they were tested, so a mixed culture could be made, so that a mixed culture would produce a maxi-
144 mum benefit to the crop, whereas if that culture contained an inhibited strain, then a reduction in yield would occur due to this inhibition effect, due to mixture.
145 Mr. Thiess: Does that clarify that? If not, we will go into that a little more fully, later on.

The Court: I think I understand it. I don't understand how he gets the noninhibitive strain.

The Witness: Some strains, when mixed, will reduce the yield and other sets of strains, when mixed, do not reduce the yield.

The Court: Yes; I understand that, and the strain is the—

The Witness: —is the individual organism isolated from the nodule and in the stock test tube.

The Court: That is the organism and the strain applied to the organism, whether it is a good strain, a bad strain, or extra-good strain.

The Witness: Yes, starting out with a good strain in a single culture, it doesn't make an appreciable difference

whether it is an inhibitive one or not; that is, whether it is subject to inhibition.

Used in a single culture it would be a good strain but to use that in a mixed culture without testing it first to be sure that this inhibitive effect is not taking place, the results might be a substantial reduction in the yield of the crops. It was a good strain when used before and be-
146 came a poor one when it was mixed.

Q. (By Mr. Thiess) Even though it was a very good strain for a single culture?

The Court: All right.

Q. (By Mr. Thiess) All right; we will just forget this chart for a moment and I would like to have you explain, just to divert for a moment, what is meant by humus in this art.

A. Humus is a muck soil. This particular humus comes from Manitou, Illinois, and is subjected to a heat treat to dry it out, and it is subsequently ground and screened and bagged, of course, and it comes from a muck soil; its source is muck soil.

The Court: What is the word?

The Witness: Muck, m-u-c-k.

The Court: What does that mean,—a real heavy black soil?

The Witness: Yes; it is a heavy black soil and has a high percentage of organic matter in it. It is decomposed swamp soil.

147 Q. (By Mr. Thiess) Rather good to grow plants in, is it?

A. Plants grow in it very well if it is supplemented; I believe it is deficient in potash, so far as the soil is concerned.

Q. I presume his Honor understands what you mean by this and you have used it throughout, but I think you had better explain what you mean when you refer to host plant.

A. Host plant?

Q. Yes.

A. That is the plant on which a given species of bacteria will form nodules.

Q. Now, you have referred to various articles in the literature that you studied prior to the time that you did your work on these various bacteria, to find inhibition, and one of these is an article by Max Kronberger.

Mr. Thiess: Your Honor, this is a German article and we have stipulated as to the English translation. I would like to offer that stipulated English translation in evidence as Plaintiff's Exhibit 11.

(Said document headed: "On Mutual Retardation and Favoring Between Nodule Bacteria", by Max Kronberger; Bavarian Agricultural Institute for Plant
148 Culture and Plant Protection, Munich, Germany, being a Stipulated English Translation, was thereupon marked as Plaintiff's Exhibit 11 for identification.)

Mr. Greer: The translation or the original article?

Mr. Thiess: The translation, to which is attached the German article.

The Court: Now that is an article that the witness says he studied; do I understand that correctly?

The Witness: Yes.

Mr. Thiess: Prior to the time he made his invention.

The Court: All right.

Q. (By Mr. Thiess) Now referring to this Kronberger article, will you please state what you found in this article with respect to inhibition?

A. This article by Max Kronberger on the Mutual Retardation and Favoring between Nodule Bacteria, published in Praktische Blätter für Pflanzenbau und Pflanzenschutz, Vol. XIV, No. 7, pages 203 through 209, 1936, shows that Kronberger prepared the mixed cultures of all different species of root nodule bacteria and grew them together on jelly slants similar to those we have been discussing here.

He took the pots filled with quartz sand and soil and
149 planted sterilized seeds of the different cross-inoculation host plant groups in the different pots, and he also compared each of these mixtures with the individual strains of bacteria that he used to prepare the mixtures with in the first place.

The results that he obtained,—in every case the mixed cultures had a lower yield in dry weight than the unmixed cultures, the single cultures.

He had a total of six different mixtures containing red clover bacteria with different species of other legume bacteria in combination. In every case the mixture producing lower yield than the red clover bacteria used alone.

He found similar results with alfalfa, serradella, horse bean, peas, vetch, and yellow lupine. These last six plants were only tested with one mixed culture each.

That is, he tried red clover with alfalfa and red clover mixed with serradella, and compared it with the single species,—he compared the mixture with the single bacteria, and in every case in these mixtures, the mixture produced a lower yield than the single culture used alone.

Kronberger concluded that the nitrogen fixing ability of the nodule bacteria and, therefore, the yield of leguminous crop was interfered with by the presence of other species and he also concluded that the use of a universal or a mixed culture for the inoculation of various legumes was a great mistake because this mixture would never give the same increase in yield that could be obtained from the same cultures used alone.

150

This report was from the Bavarian Agricultural Institute for Plant Culture and Plant Protection, Munich, Germany. That is one of the agricultural experiment stations in Germany.

Q. And does this article show any of the percentages?

A. Yes.

Q. Have you got those readily available?

A. Yes; in the case of red clover and alfalfa, when he mixed alfalfa with the red clover bacteria, a 9.25 percentage decrease was obtained, in comparison with the same red clover bacteria when used alone.

This decrease was based on the total yield of the plant. In this case he didn't take into consideration the uninoculated controls.

Based on the difference that he obtained with the culture single compared with the culture mixed, there was a 25% decrease due to the mixture of the two strains.

In the case of alfalfa plants, the alfalfa plants inocu-

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lated with a mixture of alfalfa and red clover bacteria he obtained a 21.54% decrease under the host culture, or the single culture, and similar percentages were obtained all down the line. It varied from approximately 5% to 35% reduction in yield in every case. There wasn't a single exception.

Q. Now, in this Kronberger article he refers to some work done by Hiltner. Did you look up that article at the time to determine what Hiltner had to say?

A. Yes; L. Hiltner, in a paper on the development of crop yield, especially of serradella, through inoculation with nitrogen,—this was a product prepared by Hiltner in Germany. This was published in the Jahrbuch der Deutschen Landwirtschafts-Gesellschaft, Volume 23, 299-301, in 1908.

This report was given at a meeting of the Agricultural Society at Stuttgart on Friday, June 26, 1908.

A. (continued) Hiltner observed that frequently the previous crop of legumes affected the yield of the following crops, and was familiar with other observers or other
152 investigators who observed the same thing.

He referred to two other references in the agricultural press,—this is the German agricultural press—in which red clover was a failure after previous crops of vetch or peas, but not after field beans.

He also observed that Spanish peas failed after growing on a field where vetch had previously grown. Investigating the reasons for this he tried some experiments in pots similar to the pots that we have here and in the presence of red-clover bacteria, serradella seeds inoculated with serradella bacteria show a marked decrease compared with serradella bacteria used alone.

Mr. Greer: May I interrupt? As I understand it he is not referring to the Kronberger but to the Hiltner article.

The Witness: I am referring to the Hiltner article; that is correct.

Mr. Greer: Do you have that Hiltner article here? I do not think it is proper for him to say what the Hiltner article says unless it is going to be introduced into evidence.

Mr. Thiess: We have the Hiltner article here. If you want it introduced in evidence,—we thought it might be well if he would just comment on it.

153 Mr. Greer: We certainly do if he is going to comment on it.

The Court: Without offering it into evidence you can produce it and submit it to counsel.

Q. Now Kronberger also refers to an article by Weigert and Weizel.

Mr. Thiess: And we have a copy of that that we will supply to Mr. Greer. That is the article referred to in the Kronberger article.

154 Q. (By Mr. Thiess) Now, will you please state what this article concludes?

A. This article, by J. Weigert and H. Weizel, entitled: Observations on the influence of previous and cover crops on the development of red clover, was published in Praktische Blätter für Pflanzenbau und Pflanzenschutz, Volume 12, pages 243 through 249, 1935.

This is another report from the Bavarian Institute for Plant Culture and Plant Protection, Munich, Germany.

Weigert and Weizel observed in field experiments that red clover was greatly affected by the previous crop that had grown on the field.

Field beans had an extremely marked— That is, a previous crop of field beans appreciably reduced the yield of red clover which was planted there the following year.

Also in another field planted to red clover along with a cover crop the previous year he had grown potatoes and alfalfa and in that field they had grown potatoes in the previous year a substantial yield of red clover was obtained.

On that part of the field which grew alfalfa there was a very marked reduction in yield.

In his conclusions the authors suggested an investi-
155 gation should be made on the reduction of clover through microbiological means.

By that they were suggesting, or I interpret it this way, that they were suggesting the possibility of the root nodule bacteria being a factor there.

Subsequently Kronberger did his work to check back to see if the root nodule bacteria were a factor in the reduction of that yield. I believe that covers that article.

Q. And then there is another article referred to in the Kronberger paper which is Gerlach and Vogel; is that correct?

A. That is correct.

Q. And what does that article state about inhibition?

Mr. Thiess: (handing paper to counsel) We have handed counsel a copy of the Gerlach and Vogel article, with a translation.

A. Gerlach and Vogel, in a paper entitled: Observations on the Action of Hiltner's Pure Culture for Legumes, published in the Centralblat für Bakteriologie, Parasitenkunde und Infektionskrankheiten, Second Part, Volume 20, pages 61 through 71, in 1908.

Gerlach and Vogel had made an experiment in the pre-

vious year in which they had inoculated and uninocu-
156 lated plants of lupine, soybeans, and serradella in parcels,—they called them. They were masonry structures containing a mixed sandy soil, and they obtained a marked increase due to the effect of inoculation, but the following year they planted in these parcels lupine plants inoculated only with lupine bacteria.

They started out investigating the moisture relationship demand of the lupine plants, but during the year they observed that the lupine seeds inoculated with the lupine culture planted in the parcels of the previous year had serradella bacteria in them and were carried over to the following year, there was a marked increase in yield.

However, where the soybeans had been in in the previous year and the soybean bacteria had been in, there was a marked reduction in yield, when the lupine was planted in these parcels and inoculated with the lupine bacteria.

Well, in their conclusions they indicated that serradella and lupine were of the same cross-inoculation group, or they thought their experiments indicated they were, and in all probability, in the light of our current knowledge, the increase in serradella was due to the more efficient strains
of serradella organisms than the lupine organisms
157 which were deliberately added to the culture.

At this time the differences in efficiency of strains wasn't definitely established, and they also concluded that lupine bacteria following soybeans were either completely destroyed or rendered wholly inactive, indicating that their conclusions from their own observations were that the lupine organisms were affected by the soybean organisms which were left there from the previous year.

Q. Now there is one other article referred to in the Kronberger article. Does that have any bearing on it?

A. That article is by Heinze. On investigation there was no indication, in the Heinze article, of distinct antagonism or inhibition.

He reported a lack of formation of nodules on, I believe it was, clover following peas, and some other crop, but if there weren't even enough organisms there to form nodules, it would be difficult to measure the inhibition effect; there probably weren't organisms there, so I didn't take that paper into consideration.

Q. Well, I now wish to refer you to an article or report

by A. G. Lochhead, of the Department of Agriculture of the Dominion of Canada, Division of Bacteriology, published in 1934, and ask you to summarize the results
158 which are referred to in the report with respect to mixed cultures.

Mr. Thiess: I would like to offer this in evidence as Plaintiff's Exhibit 12.

(Said pamphlet entitled Division of Bacteriology, Progress Report of the Dominion Agricultural Bacteriologist, by A. G. Lochhead, B.A., M.Sc., Ph.D., for the years 1931, 1932 and 1933, was marked as Plaintiff's Exhibit 12, for identification.)

A. The progress report of the Dominion Agricultural Bacteriologist for the years 1931, 1932 and 1933: On page 9 of this report, under the title: Examination of Miscellaneous Inoculants, Lochhead concluded as follows:

"Furthermore, cultures containing bacteria for treating legumes of different cross-inoculation groups were unsatisfactory. Where two strains of Rhizobia are mixed in a single culture there is the probability of one strain being suppressed and it is therefore recommended that an inoculant contain bacteria of but one cross-inoculation."

He very definitely advised against the use of composite cultures.

Q. Now to what extent, if any, to your knowledge,
159 are these reports of the Dominion of Canada Department of Agriculture circulated in the United States?

A. These are circulated throughout the libraries of the agricultural colleges and the agricultural experiment stations.

160 Mr. Thiess: Q. I now wish to refer you to the book entitled "Root Nodule Bacteria and Leguminous Plants", by Edwin Broun Fred, Ira Lawrence Baldwin, and Elizabeth McCoy, published in Madison, Wisconsin, in 1932. Will you state how this publication is regarded by men skilled in the art?

A. This publication is regarded as a standard reference text in the field of root nodule bacteria and the relationship to leguminous plants.

Q. I now wish to refer you to photostatic copies of pages 244 and 245 of this book, and ask you to kindly state what these authors say about mixed cultures, and I would

like to introduce this photostatic copy of those pages, together with the title page of the book, in evidence as Plaintiff's Exhibit 13.

(Said pages 244, 245 and 254 of the book entitled Root Nodule Bacteria and Leguminous Plants, by Edwin Broun Fred, Ira Lawrence Baldwin and Elizabeth McCoy were marked as Plaintiff's Exhibit No. 13.)

161 Mr. Thiess: Q. Now, will you refer to the photostatic pages that are received in evidence as Plaintiff's Exhibit 13 and state what these authors say about mixed cultures?

A. Well, on page 244:

"Composite culture: The desire to have one culture for several crops has led to the preparation of the so-called 'dual purpose' or 'universal culture', Bredemann, 1912, and Vogel, 1917. In some such preparations, rhizobia of only two or three cross-inoculation groups are included, while in others the makers have gone to the extreme of mixing representatives of all of the more common cross-inoculation groups. Although this method may bring about fair nodule formation, the results are variable. The writers feel that composite cultures offer few advantages and certainly many disadvantages. Perhaps the only justification
162 for the mixing of strains is in the case of the small-size garden culture. Because of the limited amount of seed to be sown, it may be desirable to have one culture containing the organisms for such crops as beans and peas and thus to reduce the cost of inoculation."

Q. Now, before you go to page 254, will you explain a little more in detail what is meant by these small sized garden cultures that are referred to in this article?

A. Well, the garden cultures are mixed cultures containing two or more species of legumes commonly grown in the home vegetable garden, and also includes certain legume flowers. The most important of the garden legumes that are inoculated are sweet pea flowers and lupine flowers and garden beans and garden peas, and in addition there are cultures prepared to benefit lima beans and edible soy beans.

Q. What is the fundamental distinction between this so-called garden culture and the field culture that we are interested with in this case?

A. Well, the fundamental difference between the field and garden cultures is that the—well, the garden culture is intended to be used in small quantities. That is, the package that we prepare, for example, for garden inoculants, contains one ounce and is recommended for use for, oh, up to five or ten pounds of seed. Usually the purchaser of a garden inoculant package uses it on a small package of seed, and the size of the package is not important; that is, there is usually an adequate amount of material there to thoroughly inoculate these seeds.

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But the importance of the culture economically,—that is, so far as its benefit is concerned, garden cultures do benefit the garden crops and flowers, they do produce an increase over what the back yard garden would get without using a culture, but no one has been interested enough in these garden cultures to determine whether he is going to get that maximum benefit. It is really important with the field crop culture.

To the best of my knowledge there are no tests in which the individual species contained in the garden culture has been tested alone and in combination. Most commercial companies, or at least I will speak for our company in regard to garden cultures; we do test the individual species that go into—or we did prior to the patent, we tested the individual species to make sure the species going in there were good, and then simply mixed them together and sold them as garden inoculant. We did not know what effect the mixing them together may have.

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The Court: Q. Have you since learned?

A. We have checked it since that time, yes.

Mr. Thiess: Q. Well, to what extent is this inhibition important in these garden cultures?

A. Well, if a garden culture should contain poor strains, it would still produce some benefit to the gardener, but the loss of a few sweet pea blossoms or a few beans would not appreciably affect the use of the culture. That is, as long as he was getting some benefit out of it, that is the important point.

Q. But when you are talking about field cultures what is the situation?

A. Well, cultures for application to field seeds is approached in an entirely different light, and you have at stake a very definite economic consideration. That is, if a culture for field seed should be made in strains that you did not know were good, it might result in a very great reduction in yield and therefore an actual loss to the farmer in using that culture. Therefore, in presenting a culture where we need an absolutely maximum yield that we can get in crops, the use of efficient cultures is extremely important.

Q. Now, will you discuss page 254?

The Witness: On page 254, about two-thirds of the way down the page, just above No. 1, the authors make the following statement:

"To the authors the value of a culture seems to depend in a large measure on at least five factors.

1. Upon the organism. It is essential that the culture of bacteria contain the proper organism to form nodules on the desired host plant. In general, it is desirable to have only the one type of organism in the culture.

2. Upon efficiency of strain. Select an active strain of the desired organism. Because of the variation between strains in relation to effectiveness, every effort should be made to select strains of the bacteria which are known to be of decided benefit to the host plant, and to keep these tested cultures under conditions which will maintain the organisms in an active state."

Q. Now, as I understand it, these various publications that you have referred to were among the literature which you considered in the summer of 1937 to show that a mixed culture was not a practical inoculant, is that correct?

A. That is correct.

Q. Now, are there any others?

A. Well, there are other references to mixed cultures that were recommended not only for legumes but also for non-legumes. And in general none of these cultures proved satisfactory. Occasionally fair results were obtained, but in most cases, especially those that were supposed to cover everything, they were very unsatisfactory.

Q. Well, have you any of those that you can refer to?

A. Bredemann tested—G. Bredemann, in an ar-
167 ticle entitled "Investigation of the bacterial preparation, 'Kyles, concentrated nitrogen producer' (it was composite farmogerm)" in the book entitled "Jahrbucher", Bredemann tested one of these mixed cultures to determine what legume organisms were present in the culture. He found that there were some, that there was lupine organisms and alfalfa bacteria there in unbalanced quantities, but he could not find any red clover, vetch, horse bean, field pea, sweet clover legume bacteria. He did find contaminants, including a red yeast, a spore-former, a red and yellow cocci, and a small rod shaped organism. The author concluded that the culture was unsatisfactory for the purpose recommended.

Q. Have you any others that you can refer to specifically, or is that all?

A. Well, we have some other references in regard
168 to these mixed cultures that were recommended for all crops.

Q. Have you got those available?

A. Yes.

169 Whereupon, at 5:00 o'clock p.m., an adjournment was taken to Tuesday, June 26, 1945, at 9:30 o'clock a.m.

170 In the District Court of the United States
Southern District of Illinois
Southern Division

Tuesday, June 26, 1945, 9:30 o'clock a.m.

Trial resumed pursuant to adjournment.

171 Mr. Thiess: The first thing this morning, if Your Honor please, I would like to offer all exhibits which have not been offered.

The Court: They may be received in evidence. I have already received 1 and 2, but have not acted on the others.

Mr. Thiess: That is right. They are now received.

(Said exhibits, so offered, were received in evidence by the Court and marked respectively Plaintiff's Exhibits 3 to 13, both inclusive.)

172 Q. Mr. Bond, you have got a copy of the record there, have you not?

A. Yes, I have.

Q. I understood you wanted to make a correction regarding your testimony on pages 163 and 164.

The Court: You are referring to pages of the current transcript?

Mr. Thiess: Of the transcript, yes.

Q. Will you refer to that and make the correction that you desire?

A. Yes, on page — Should I quote what is here and how I want it changed?

Q. That is right.

A. On page 163, the last line on the page, I said:

"we do test the individual species that go into—or 173 we did prior to the patent, we tested the individual species to make sure the species going in there were good, and then simply mixed them together and sold them as garden inoculant. We did not know what effect the mixing them together may have.

"The Court: Q. Have you since learned?

"A. We have checked it since that time, yes."

I would like to change that in that we, prior to the patent we did not test the strains used in our garden inoculant for efficiency. We obtained these strains from a source that we knew was reliable and the strains were recorded as good or efficient strains.

Subsequent to the time the patent was issued, we have tested these strains individually and have confirmed the previous report in that they are good strains but we have not had the time to test them alone and in mixture. These tests, these efficiency tests, require a lot of work and a lot of time.

We directed our efforts to the most important cul- 174 tures in the group. Those were the field legumes but I have not tested the single strains of the garden cultures in comparison with the mixture.

Q. Now, have you finished that, Mr. Bond?

A. Yes, sir.

Q. Now, when we adjourned last night you were referring to the articles in the literature that you had studied in the year 1937. Now, have you any other articles that

show that mixed cultures were unsatisfactory that you found when you made this study?

A. Yes, Doctor Lockheed, Dominion Agriculture Bacteriologist of Canada, in his report for the years 1929 and 1930 for the Division of Bacteriology reported on tests with Growmore which was claimed to be a culture satisfactory for all legumes and found that it did not compare with the single cultures made by his department in the formation of nodules on alfalfa and peas. These were the only legumes on which he tested this culture.

Lockheed in a similar report for the year 1925 on page 16 tested two other cultures of the same type as Growmore on peas and found unsatisfactory nodulation of peas.

Q. Did you say page 16, is that correct?

175 A. Excuse me.

Q. We haven't photostated it as page 16,

A. The test is on page 18. The start of his work is on page 16.

Q. Now, have you any others?

A. Paul Emerson in Bulletin Number 214 of the Maryland State College of Agriculture, Agriculture Experiment Station, reported on tests of an "all crop soil" inoculant.

On page 142 field tests were made with soy beans. The soy bean seeds inoculated with this culture did not produce as great a yield as the soy bean seeds which were not inoculated. This culture was obviously unsatisfactory on soy beans, the only legume on which tests were made.

Doctor L. T. Leonard in a paper entitled "Some Tests With Soil-Gro", it is presumed to be the same culture Lockheed referred to.

In the journal of the American Society of Agronomy, Volume 17, pages 626 and 628, 1925, they found that this alleged all crop inoculant varied from one sample to the next in its formation of nodules on the different legumes.

It also did not increase a crop of peas in field experi-
176 ment tests.

Doctors Conn and Hofer in Circular Number 137, Revised, New York State Agriculture Experiment Station entitled "Soil Inoculant Service" on page 3 states:

> "Whereas in 1931 and 1932 the tests showed that a high proportion of the cultures were unsatisfactory, in 1933 they indicated a much smaller percentage as inferior. This last year the poor products were often

found to be mixed cultures sold in smaller containers recommended for garden purposes."

They also reported on unsatisfactory tests with a number of these all crop inoculants.

There are many tests in the literature indicating that others of these mixed cultures did not form nodules on their respective plants. These are examples of typical
177 references of that nature.

Mr. Thiess: Q. All right. Now, in the light of this study of the literature, what were your conclusions respecting the possibility of producing satisfactory composite or mixed cultures for leguminous plants?

A. Well, I found these many references which showed that mixed cultures for legumes as well as non-legumes were not satisfactory.

Kronberger and his Accessory References, namely, Hiltner, Gerlach and Vogel, and Weigert and Weizel, as well as Lockheed, Fred, Baldwin and McCoy strongly indicated the existence of antagonism or inhibition when different species were grown together.

From these references I concluded that the use of mixed cultures for field seeds was an impossibility.

I think that sums it up.

Mr. Thiess: Q. And having arrived at this opinion what, if anything, did you do in view of Mr. Lusk's instructions to you to produce a composite or mixed culture for leguminous plants?

A. Well, I told Mr. Lusk that although I thought a satisfactory mixed culture could be prepared that
178 would contain all the different species in adequate number to thoroughly inoculate the respective host plants for which they were recommended, we would still have this problem of antagonism or inhibition entering into the picture and the culture would not produce optimum results when used in the field.

Q. And having so informed Mr. Lusk, you then made the tests you referred to yesterday?

A. Yes. Mr. Lusk suggested the least we could do would be to try it and see to what extent this inhibitive or antagonistic effect would carry through into the culture.

Q. And what conclusions did you draw as a result of your tests?

A. The tests that following fall, the fall of 1937, I prepared several different mixed cultures with different strains and of different species mixed together and the first test was set up in the late fall of 1937 and, due to the fact we did not have supplemental lighting in the greenhouse, it was discarded. None of the plants showed sufficient growth to tell the difference between inoculated and uninoculated control.

The second experiment was set up in the spring of that year and in that experiment we found that certain 179 strains would inhibit others in a mixed culture, corroborating the evidence that was already in the literature but, in addition to that, we found some of those mixtures did not cause those inhibitions, did not reduce the yield, which showed to me if they were selected and proper cultures made, satisfactory cultures could be made.

In the meantime I run tests to see if there were an adequate number of these organisms present to form nodules but even at dilutions fifty times that recommended on the package nodulation was obtained on all these species that were included in the mixture.

Q. Now, are there any other publications than those you considered in 1937 which indicate that inhibitions exist?

A. Yes, in the report of the Dominion Agriculture Bacteriologist, A. G. Lockheed, for the years 1934, 1935 and 1936, on page 15 he made the following statement at the bottom of the page. This is under the sub-title "Examination of Miscellaneous Inoculants".

> "Moreover, inoculants containing bacteria for but one cross inoculant group are believed better than 180 those containing bacteria for two or more leguminous groups, since tests have shown that in mixed cultures one strain may become effective."

This report was published in 1938.

Another paper indicating the influence of the different strains of root nodule bacteria on each other, even within the same species, was published in the Journal of Agricultural Research, Volume 46, 1933. This paper is entitled "The Effects of Non-beneficial Nodule Bacteria on Austrian Winter Peas", and is by L. T. Leonard and W. R. Dodson.

On page 658 there is a table on the nitrogen fixed by different pea cultures on Austrian winter peas. Two of the—all of the tests were on individual strains except in one case a mixture of two strains was included.

This mixture of two strains produced a lower yield than either one of the strains used alone, indicating that the association of the two strains together produced a marked inhibition on either one or both. This inhibition in one case amounted to 95 per cent—these figures on inhibition are my own, I just took the data and calculated the
181 degree of inhibition here—and on the other strain amounted to 85 per cent.

The authors state:

> "When the two types of organisms (512 and 513) were used together the total nitrogen fixed was not greater than that fixed by the non-beneficial organism alone."

This paper indicates an amplification of the other literature in that inhibitions may exist not only between species but even between strains within a given specie.

These strains were both pea strains.

Q. All right, Mr. Bond, I wish you would now refer to your patent in suit and state whether or not you have enumerated therein any of the data which you obtained as a result of the tests you conducted which proved to your satisfaction that there were inhibitive strains. And I call your particular attention to page 4 of the patent, column 1 through column 2, line 56.

182 The Witness: Yes, I see. The easiest way to give these tests would be merely to read what is in here.

The Court: The question is, did you refer to them in your patent?

Mr. Thiess: Q. Did you refer to them in your patent, the tests you made prior, that you have been talking about?

A. Yes.

Q. Did you refer to those in your patent?

A. Yes, I have.

Q. And these tests show what results?

A. Well, these tests showed that certain strains when mixed with other species a definite inhibition was observed but when other strains were mixed with other strains of different species that inhibition was not observed.

Q. And in these tests that you made on page 4, which were made to show this inhibition, what was the percentage of inhibition if it is available that you found?

A. Well, in the case of the soy bean plants the mixture containing inhibitive strains compared with the single strains, the same single strains, the following results 183 were obtained.

There was approximately a 35 per cent increase when the single strain was used as compared with the mixed, that same strain mixed with the others. That is indicated on line 41, column 2.

The same thing was true of the red clover plants. The single strains of red clover produced 118 per cent more nitrogen than the mixture. That is indicated on line 52.

Q. I now refer you to your patent at page 6, beginning with column 1, line 25. Are the test results here indicated results of tests you actually made?

A. Yes, they are.

Q. Will you please state a little more fully what these tests are and what the tabulation you have in your patent indicates?

A. The table starting on line 62 shows the following:

Q. Before you go to the table you had better state how these tests were made.

184 A. These tests were made in the same manner that the efficiency tests were made, as illustrated in Exhibit 5. The first column, Inoculant Series Number, lists the number of the different cultures that were tested.

There is a total of five, one of which was an uninoculated control. The first number, 1, is the uninoculated control. Number 2 is an inhibited strain used unmixed or in single culture.

Number 3 is a noninhibitive strain, also used unmixed or in single culture. Number 4 is the inhibitive strain when mixed with other species, and Number 5 is a non-inhibitive strain when mixed with other species.

The second column refers to the grams dry weight for ten plants, determined in accordance with Exhibit 5.

The third column—

The Court: What is that you are weighing there, grams?

The Witness: Perhaps I can show it better by referring back to this exhibit.

A. (continued) In Exhibit 5 the grams dried weight is obtained from the total weight of the dried plants.

The Court: How is that now; go ahead?

A. (continued) Dried weights are obtained in ac-
185 cordance with box 8 on the diagram. That is, it is the plants similar to these that we have over here where the sand is washed from the roots and those plants are dried and the plants, after they are thoroughly dried, are weighed.

Q. (By Mr. Thiess) The entire plant?

A. The whole plant, yes.

The Court: All right.

A. (continued) And then the dry weight per plant can be determined merely by dividing by the number of the plants in the pot and can be converted to ten plants, 100 plants, or any unit.

10 was a convenient figure in this chart because it was easier to figure in the subsequent calculations.

Column 3 indicates the percent nitrogen in each of these samples and the percent nitrogen was determined in accordance with box 9 in Exhibit 5. The milligrams—

The Court: That means the amount of nitrogen absorbed by the plant?

The Witness: No; that is the total amount of nitrogen that was found in the plant. The plant was analyzed for its nitrogen or protein content.

The Court: Of course this was after the plant has grown.

186 The Witness: The plant had grown. These are the results on grown plants.

Mr. Thiess: Your Honor, you understand that is all nitrogen, some of which is in there due to inoculation and some possibly due to the earth.

The Witness: That is right.

Q. (By Mr. Thiess) Will you continue?

A. From these two figures we obtained the fourth column, milligrams of nitrogen per 10 plants, the product of the grams dry weight times percent nitrogen, gives the milligrams of nitrogen per ten plants.

Q. Will you go to the next column?

A. The last column is the milligrams of nitrogen fixed per ten plants and is the difference between the inoculated series numbers 2, 3, 4 and 5, and the uninoculated series

1; that is, 1 is subtracted from all of the others and that is the actual amount of nitrogen fixed by the bacteria from the air.

Q. Now in column 4 the figures that are marked all carry an asterisk, and the asterisk refers to standard deviation of the mean of a series of five jars.

Now, without going into this in an elaborate manner, will you kindly state what is meant by the standard
187 deviation of the mean?

A. The standard deviation of the mean is a statistic calculated from the samples to show whether differences between the means, that is, differences between the milligrams of nitrogen fixed per ten plants is a real difference or only an apparent difference.

It is an objective method to determine if there is a real difference between these two determinations.

Q. Statistically that is an accepted method of making that sort of a determination?

A. That is correct.

Mr. Thiess: That is, I think, all that your Honor needs, that it is an accepted method.

Q. (By Mr. Thiess) Now you refer there to a series of five jars. Did you use five jars in all of these tests?

A. In checking over the data prior to the patent trial I noticed that Inoculant Series Number 2 and Inoculant Series Number 5 had three replicates in it instead of five.

Mr. Thiess: He means three jars.

A. (continued) Three jars. Three replicates.

However, that does not reduce the significance of the results; that is, as long as the statistic, the standard
188 error of the mean, is determined, samples containing this number of replicates can be accurately compared.

The reason that several jars are used in each of these experiments is that there is an inherent variation between different plants, between the seeds, and to use the single jar would not give you sufficient information to accurately know whether there was any real difference between the uninoculated and inoculated plants.

When the difference is as extreme as we have here, when you compare the differences between inoculated plants it is necessary to run each series that is inoculated in replicates, preferably at least three, and that will give you data to which statistical methods may be applied, to objec-

tively determine whether there is a real difference between your averages or just an apparent difference.

Q. (By Mr. Thiess) Now, what does this table show in your patent with respect to inhibition with respect to the various plants that were tested?

A. Well, the Inoculant Series Number 2 containing the inhibitive strains in single culture fixed as much nitrogen as Number 3, the noninhibitive strain used in single culture, and the noninhibitive strain in Series Number 5 used in mixed culture.

189 Now, there is a difference between these three means, but the fluctuation of the standard error indicates that that difference is apparent and not a real difference.

In this particular test we did not measure any real difference between those three cultures.

The Court: What you are talking about is 2?

The Witness: 2, 3 and 5.

Q. (By Mr. Thiess) Now, will you just so that his Honor will get that, repeat what 2, 3 and 5 are?

A. 2 is the culture containing inhibitive strains alone. 3 is a culture containing noninhibitive strains alone, and culture 5 contains noninhibitive strains mixed with other strains.

Q. And as to those 3 you got—

A. There is no significant difference between those three cultures.

Q. Now, will you go to the others?

A. Culture 4 containing the inhibitive strain in a mixture produced a significantly lower yield than any of the other three cultures; that is, comparing it directly with the same strain used unmixed, that is Series Number 2, there is a distinct loss or distinct effect of inhibition observed there.

190 A mixed culture prepared commercially from the strains used in Inoculant Series Number 2 would produce a culture that would not yield maximum results when used by the farmer in the field.

On the other hand, the noninhibitive strains, Inoculant Series Number 3, did not show any decrease when used in a mixture and as compared with 5, the same strain used in a mixture. 3 and 5 contain the same clover strains where the Number 3 strains were used unmixed; 5, where the strains were used, mixed. There is no significant differ-

ence between 124.5 plus or minus 15.8, and 119.5 plus or minus 39.7.

Q. Now in this data you have referred to in your patent you used the standard deviation of the mean to get your statistical analysis to show what the results would have been if you had carried on over a much larger number of plants.

Have you any other methods, statistical methods, for doing this?

A. Well, an extension of the same method, that is a finer tool for measuring these differences, is a method that is called analysis of variants.

This same standard error is determined on a different basis and is a more accurate estimation of the error
191 that is occurring in the experiment, due to conditions that are either beyond control or induced by the operator himself.

Q. And have you applied this method of analysis of variants to the test data reported in your patent and to other tests?

A. Yes, I have.

Q. And what was the result of applying this analysis of variants to the test results shown in your patent?

A. I obtained the same significant figures that are indicated in the patent by using this method. It is a more extensive method of analysis.

Q. Did you apply this method of analysis of variants to some others of your tests?

A. Yes, I have.

Q. Now, as I understand it, you have some tests which are marked U2-38, is that correct?

A. That is correct.

Q. Will you please give the results that you obtained by applying this analysis of variants to these tests with respect to inhibition?

A. In an experiment, U2-38, on red clover plants,
192 significant inhibition of one set of clover strains was obtained when alfalfa, soybean, pea, bean and lespedeza strains were used.

In this same experiment significant inhibition of a second set of clover strains was obtained when mixed with two other sets of alfalfa and soybean strains.

Q. With what result?

A. Significant inhibition was obtained. In this same experiment, U2-38, on soybean plants, significant inhibition of a set of soybean strains was found when they were mixed with clover, alfalfa, pea, bean and lespedeza strains.

In an experiment, U2-38, on Austrian pea plants, a significant stimulation of a set of pea strains mixed with clover, alfalfa, soybean, bean and lespedeza strains was obtained.

Q. Will you explain what you mean by that?

A. By stimulation there was a significant increase in yield when these pea strains were mixed with the others.

This is an additional effect that I did not know of at the time the patent was applied for, and there was no indication of it in the literature, and I was very much surprised to find it as well as even to find that no inhibition could exist.

193 But to find in addition to that,—you may even in certain cases get stimulation, was just another indication that the association of organisms together can definitely influence the nitrogen fixing characteristic of the particular strains.

In some cases it will lower it and in some cases it may increase it. In other cases there is apparently no effect.

Q. And that therefore it is necessary to make an efficiency test on these strains, combined so as to know that your ultimate results would be satisfactory?

A. If an efficiency test is not made to determine that the final product is producing optimum yield, there is no way of knowing what it will do when it is finally used in commercial use.

Q. Now, have you some other tests?

A. In U2-38 on alfalfa plants two different mixed cultures produced no significant inhibition or stimulation.

In an experiment later the same year, U3-38, on red clover plants, significant inhibition of a set of clover strains when mixed with alfalfa and soybean strains was obtained.

In this same experiment on soybean plants, that is, 194 U3-38, significant inhibition of soybean strains was found when these were mixed with clover and alfalfa strains.

In another experiment, conducted in 1940, U1-40, on clover plants, a significant stimulation of one strain of clover by one strain of soybeans was observed.

The Court: That means mixing of the soybean and the clover?

The Witness: Yes.

A. (continued) That soybean strain was mixed with one clover strain. On clover plants the clover was tested alone, and the clover plus the soybean strain were tested together, and a significant stimulation,—an increase of yield was obtained in the presence of that soybean strain.

The Court: When was that experiment made?

The Witness: That experiment was made in 1940.

The Court: After the patent?

The Witness: This was after the patent.

Mr. Thiess: All these are further tests that he made to show—

The Court: I understand. Your product here is a combination product covering soybeans, clover and alfalfa, isn't it?

The Witness: We have two products. One of them is 195 recommended for alfalfa, clover and soybeans.

The second product is recommended only for alfalfa and clover; there is a different demand for the different products in different areas, different territories.

The Court: The patent in suit here—is it limited in its claims?

Mr. Thiess: No, it is not. The patent is not limited in its claims.

The Court: And limited to any particular combination?

Mr. Thiess: No; under the claims in suit.

Mr. Greer: It is not dependent upon or rather it is dependent upon what you mean by limits. There are some of the claims that are limited to the alfalfa and the clover group and some of them have limits as to the effect on the alfalfa bacteria. Then there are others that say that there is no limitation and that there is no inhibition in his product as to all of the groups, so that your Honor's question cannot be answered specifically as to all of the claims.

Mr. Thiess: We are saying merely that the claims in suit—

Mr. Greer: I mean the claims in suit.

Mr. Thiess: —are not limited to three or more 196 strains of bacteria.

The Court: The claims in suit are 1, 3, 4, 5, 6, 7 and 8, 13 and 14?

Mr. Thiess: That is right.

Mr. Rathburn: None of them mention specifically any Rhizobia except trifolii.

Mr. Thiess: They call for trifolii and other species, which can mean clover, alfalfa and soybean.

The Court: Those are the claims in suit because they are the ones that it is contended the defendant has depended upon and Captain Greer told me in the opening statement that all claims were asserted to be invalid.

Mr. Thiess: No.

Mr. Greer: Under our counter-claim there we set up the invalidity of the whole patent.

Mr. Thiess: Yes, in their declaratory judgment counter-claim. They have a counter-claim in this suit.

The Court: Asking for a declaratory judgment upon the entire patent.

Mr. Thiess: Yes, on the entire patent.

The Court: And, of course, that does put in issue all claims of the patent.

Mr. Greer: Yes, it is not only these claims it is
197 specified, that it is claimed are infringed, but the validity of all of them are before your Honor.

Mr. Thiess: Under the counter-claim.

The Court: Maybe you told me but I don't remember your telling me there is a counter-claim asking for a declaratory judgment.

Mr. Greer: I didn't specify it as a declaratory judgment but I did state in our counter-claim we attack the validity of all the claims.

The Court: I know you said the validity of the patent as a whole was involved and that is what I was a little confused about.

Mr. Greer: That is what it is.

Mr. Thiess: I might say, just in view of your Honor's question, not only is this in the claims, but on page 5 of the patent, column 1, the sentence beginning on line 44, which reads as follows:

> "A composite culture that is satisfactory for use for inoculating seeds of alfalfa, red clover, and/or soy beans (representatives of three cross-inoculation groups) contains a mixture—"

and then he refers to these chief Rhizobia bacteria, so that means either the two or the three. They have the
198 preference. You can either add the soybean or not to the alfalfa and the red clover strains.

And it might be advantageous at this time to just read your Claim 1. This claim reads as follows:

> "1. An inoculant for leguminous plants comprising a plurality of selected cultures of different species of bacteria of the genus Rhizobium, one of said cultures being Rhizobium trifolii alpha,—"

Now Rhizobium trifolii alpha is the clover strain of the noninhibitive type. Alpha has been so explained in the patent,

> "—said cultures being substantially unaffected by each other in respect to their ability to fix nitrogen in the leguminous plant for which they are specific."

Now that claim will read on any mixed culture in which the strains are selected so that you will have noninhibitive strains and will not get inhibition and get a composite culture that would be as efficient as the single culture if the Rhizobium was used as a single culture.

Is that sufficient, your Honor?

199 The Court: Yes.

Q. (By Mr. Thiess) Now, I believe you were referring to your test that you made in 1940 which is referred to as U1-40?

A. That is correct.

Q. Will you just cover those?

A. The reference was to experiment U1-40 on clover plants. Significant inhibition of a second strain of clover was observed when mixed with one strain of alfalfa. Significant inhibition of this same strain of clover was also detected when mixed with one other strain of soybean.

In this U1-40 experiment on alfalfa plants, significant stimulation of one strain of alfalfa by one strain of soybean was observed, and significant stimulation of a second strain was observed, that is, significant stimulation of a second strain of alfalfa by this same strain of soybeans.

Significant inhibition of one of these strains of alfalfa when mixed with three strains of clover and three strains of soybeans was also observed.

In this U1-40, the experiment on soybean plants, significant inhibition of one strain of soybeans by one strain of clover was recorded.

200 Significant inhibition by this same strain of soybeans by a second strain of clover was observed and

significant inhibition by this same strain of soybeans, or, rather, of this same strain of soybeans by a third strain of clover was observed.

This particular strain of soybeans apparently was very sensitive to the presence of these other organisms.

The Court: And when you say a significant inhibition was observed, that means it was not good?

The Witness: That was not good. That mixture was not good. That is a strain not to use in a mixture containing these particular strains.

Significant inhibition of this same strain of soybean was noticed with one strain of alfalfa and significant inhibition of this same strain of soybeans was noticed with the second strain of alfalfa.

Significant stimulation of a second strain of the soybeans was observed with the mixture of one strain of clover, and significant inhibition of this second strain of soybeans was detected with another strain of clover.

Here is the same strain of soybeans when mixed with one strain of clover and there is an apparent stimulation, a significant stimulation and when mixed with another
201 strain of clover it was inhibited.

In other words, each strain in this mixture must be selected so as not to inhibit or be mutually inhibited by the other organisms.

A significant stimulation was obtained in these soybeans with one strain of alfalfa.

202 Q. Now, I wish you would please refer to the drawings in the patent and correlate them with the tests, if that is correct, that you have just referred to and are recorded in the table in your patent.

A. You are referring to the drawings on the face of the patent?

Q. That is right.

A. Figure 2 is a sample of plants obtained from one of the replicates from series No. 1, the uninoculate control series. No bacteria were added to these plants. Figure 3 is a photograph of plants from one pot in series 3, which were inoculated with a noninhibitive strain used alone, in a single culture. Figure 4 are plants taken from a pot in inoculant series No. 5, inoculated by a non-inhibitive strain mixed with other species.

There was no significant difference between the plants

shown in Figure 3 and Figure 4, showing that by the selection of a non-inhibitive strain a satisfactory composite inoculant could be made that would produce the same results as a satisfactory single culture. You see, Figure 3 is a single culture and Figure 4 is a mixed culture.
203 There is no significant difference between those two groups of plants.

Q. Now, is it ordinarily satisfactory to rely upon a visual inspection of the plants to determine whether the single and mixed cultures are satisfactory?

A. No, a visual inspection can give a rough idea of gross differences between cultures, but it is necessary to run through a specific efficiency test, in which dry weights are taken and the percentage nitrogen determined, in order to detect differences smaller than 20 per cent.

Q. And the efficiency test is the one that you have shown in Exhibit 5?

A. Exhibit 5.

Q. And described.

The Court: Q. What is Figure 1 on the patent?

A. Figure 1 is the uninoculated control plants. They had no bacteria added to them.

Mr. Rathburn: That is Figure 2.

The Witness: Oh, excuse me. Figure 1 is a drawing to show the nodules on the roots of the plant, and was taken from this book "Root Nodule Bacteria and Leguminous Plants", by Fred, Baldwin, and McCoy. It is on page 176 of this book. It was merely introduced to
204 illustrate what was meant by nodules on roots.

Mr. Thiess: Q. And the Figure A, referring to that nodule, is the same as the nodule we showed on the living plant we had here in the courtroom yesterday?

A. That is correct.

The Court: On that claim 1, for example, you are claiming in the patent, it is a process, isn't it?

Mr. Thiess: No, it is a composition of matter or manufacture.

The Court: It is a composition of matter, yes.

Mr. Thiess: We are not relying on the process claims, if your Honor please.

The Court: I see.

Mr. Thiess: All of our claims are product claims.

The Court: You claim there, "An inoculant for legumi-

nous plants comprising a plurality of selected cultures of different species of bacteria," but you don't undertake to select or limit the claim to any particular selection, do you?

Mr. Thiess: Oh, yes, we do, of the genus Rhizobium. Now, the Rhizobium is that family.

The Court: The genus Rhizobium.

205 Mr. Thiess: That is the family of this bacteria that affect leguminous plants.

The Court: Oh, one of the cultures being Rhizobium—

Mr. Thiess: —trifolii alpha. Now, Rhizobium trifolii alpha is a non-inhibitive strain. You will remember, I think, that in my opening, and Mr. Bond will undoubtedly —I will have him discuss this later on; the patent says on page 5, column 1, line 36, "The organisms of the genus Rhizobium which are mutually non-inhibitive may be designated by the term alpha."

The Court: Yes.

Mr. Thiess: And hence by using that alpha in the claim we mean a non-inhibitive strain.

The Court: Yes. But you say, "a plurality of selected cultures of different species of bacteria of the genus Rhizobium."

Mr. Thiess: Yes.

The Witness: That means red clover species, alfalfa species, soy bean species. They are considered individual species and they all belong to the same family or the same genus which is assigned the terminology Rhizobium. It is merely a subdivision in the bio-

206 logical classification.

The Court: And "being unaffected by each other in respect to their ability to fix nitrogen in the leguminous plant for which they are specific." There can't be, you say, a different species of bacteria of that one genus?

Mr. Thiess: Now, there are different species of bacteria of the genus Rhizobium.

The Court: Yes.

Mr. Thiess: Now, in this particular inoculant (Pl. Exhibit 1) we have got the two species, and they are referred to right here. The alfalfa group. For alfalfa, sweet clover, hubam, southern bur clover, and black medic. That is one of the cross-inoculation groups. You will remember the cross-inoculation group. That is the alfalfa cross-inoculation group. This also contains the clover group; for red, alsike, white, mammoth, ladino, hop, and crimson clover.

Now, you have in this particular inoculant those two species, and since this inoculant is as good as an inoculant that is used as a single culture, you have a multiple culture doing the same work. You have these alpha strains in here that give you the same result as
207 though it was a single culture.

The Court: Yes, I understand that part, but the thing that is bothering me is where it says "different species of bacteria" without saying which ones are included in the inoculant claim.

Mr. Thiess: Well, that is a broad claim. Persons might combine—this patentee having discovered that, or invented that there are these non-inhibitive strains, you could make up a composite culture of merely the clover and alfalfa strain, or you could make up one with a three and one strain, or you might make up one with a four and one strain; but as to all of these it is necessary to have these alpha strains, and hence the patentee is entitled to a broad claim covering any culture in which alpha strains, non-inhibitive strains, are used for the purpose of getting a successful mixed culture.

The Court: All right.

Mr. Thiess: Well, you understood that—Mr. Neumann just called my attention to the fact that the claim specifies that one at least must be clover, in claim 1.

208 The Court: Yes.

Mr. Thiess: You see, the Rhizobium trifolii alpha is the non-inhibitive clover strain.

The Witness: One of the reasons for that is that in previous literature the majority of the work was directed toward red clover. That is, red clover was one of those that was producing this inhibition, that was inhibited by the others.

Mr. Thiess: Does that clarify the matter?

The Court: I think it does, except I am still uncertain about this, where it says "a plurality of selected cultures." Does it make any difference which culture you select or use?

The Witness: As long as you test it to make sure that it is an alpha culture, one that will not be inhibited by others or will not inhibit others.

The Court: Well, when you say it is an alpha culture, you mean it is a red clover culture?

The Witness: No, alpha refers to the fact that it will not be inhibited.

The Court: The Rhizobium trifolii means red clover?

Mr. Thiess: That is right.

The Witness: That is right.

209 The Court: You are claiming here a plurality of selected cultures, but you don't otherwise designate the particular cultures you use, do you?

The Witness: No, this claim would cover a culture that would contain clover and alfalfa, or clover and alfalfa and soy beans, or clover and soy beans, or clover and peas, any combination in which clover was included.

The Court: Anyone preparing that product would have to make their own tests to see whether they were inhibitive.

The Witness: That is the important part of the claim, that is, your culture would have to be tested to determine that the strain was non-inhibitive before being prepared. It covers the culture so prepared in that manner.

The Court: You could prepare a culture under claim 1 and it might not be useful at all?

The Witness: Not under claim 1, because the culture has been selected so that it will be used. It has been selected, or the strains in it are selected so that it will not be inhibited by or will not inhibit the other strains.

210 The Court: Well, you say that there are a series of cultures, a plurality—

Mr. Greer: May I interrupt? I think I have a thought that would clear the matter up in your Honor's mind, concerning which there ought not to be any conflict between Mr. Thiess and myself.

The Court: All right.

Mr. Greer: The use of the expression in claim 1, and in all the others, of "selected cultures" is explained in the specification, and that means that Mr. Bonds admits that in these strains of clover bacteria, we will say, which is the trifolii group, there is one strain that is a poor nitrogen fixer. You will agree with that, won't you, Mr. Bond, there is one strain that is a poor nitrogen fixer and there is another strain that is a high nitrogen fixer? There are various strains of this clover group, in other words?

The Witness: Yes.

Mr. Greer: And some of them are high fixers of nitrogen and some of them are low fixers of nitrogen, though they do fix nitrogen.

The Witness: Yes.

211 Mr. Greer: Now, what he means by "selected strains" is that he has performed tests of the single culture of the clover bacteria and picks out from that, as a result of that test, a strain of the bacteria that is the high fixer of nitrogen. That is his selection that is mentioned in the second line of the claim there, of selected cultures.

The Witness: No. In addition to that the culture is further tested in a mixture to make sure that a high efficiency is going to be maintained.

Mr. Greer: That is the alpha.

The Witness: Yes.

Mr. Greer: But the first selection—

The Court: The selected culture means that he has selected it by experiment.

Mr. Thiess: That is right.

Mr. Greer: He has selected it by experiment as being one that he found by a previous test to be a high fixer of nitrogen itself. Then his alpha test is the second part of it.

The Court: There is no better way, I suppose, to identify the culture than to say that it is a selected culture, selected being—

212 Mr. Thiess: Being the approved methods in this art.

The Court: Yes.

Mr. Greer: Yes. I did not mean to interrupt.

Mr. Thiess: That is all right.

Mr. Greer: But it seems to me that that would help clear it up.

The Court: Yes, it will be very helpful. You may proceed.

Mr. Thiess: Q. Now, Mr. Bond, have you any photographs in which the inhibition was great enough so that it could be readily seen from the plants themselves?

A. Yes.

Mr. Thiess: I ask the Notary to mark this for identification as Plaintiff's Exhibit 14.

(Said photograph was thereupon marked as Plaintiff's Exhibit 14 for identification.)

Q. Will you now please explain what this Exhibit 14 is and what it shows?

A. Exhibit 14 is a photograph of clover plants grown

in three different pots. The first pot comprised an un-
inoculated—or plants to which no inoculation was
213 applied. They are the control plants, and there are
forty plants in each one of these groups. The second group of plants were inoculated with strains 18 and 19, used alone, unmixed or in a single culture. The third group of plants were strains 18 and 19 mixed with other strains of bacteria, and there is a definite reduction in yield due to the fact that these same strains 18 and 19 were mixed with other species. The association definitely reduced the amount of nitrogen fixed and therefore the yield of the plant.

Looking at the figures that were subsequently obtained, the uninoculated control plants contained 40.4 plus or minus 2.0 milligrams of nitrogen, but the plus or minus is the standard deviation of error. That means the figure is probably significant, from 42.4 to 38.4. It gives a range.

Strains 18 and 19 used unmixed contained a total of 141 plus or minus 11.6 milligrams of nitrogen, and strains 18 and 19 mixed with other species contained 86.7 plus or minus 5.2 milligrams of nitrogen.

The Court: Q. You don't say what they are mixed with.

A. No. These were mixed with another set of alfalfa
strains and clover and soy bean strains. There
214 were three species in this culture.

Q. You got into the soy bean strain or soy bean culture.

A. In many of the tests we have soy beans included in the mixture. This product here (Pl. Exhibit 9), this uni-culture, is for clover, alfalfa, and soy beans. That is the development of some of these tests.

Q. Soy bean is in a different group?

Mr. Thiess: Cross-inoculation.

The Witness: Yes, and so is alfalfa in a different class than clover. Alfalfa and clover are in different classes.

The Court: Are they?

The Witness: There are three species represented there, clover, alfalfa, and soy bean.

The Court: In this product there?

The Witness: In this product, in the uni-culture.

Mr. Thiess: You see, these cross-inoculation groups, if your Honor please, are referred to very clearly on page

1 of the patent, in the last paragraph in column 2, and inasmuch as that is rather important I believe it might be well just to look at that for a moment.

215 The patentee says, beginning on line 34:

> "Thus certain species of bacteria are specific to certain species of Leguminosae. The group of plants that will be infected by a single species of bacteria has come to be known in the art as a cross-inoculation group. There are at least six well-recognized species of Rhizobium which will infect six fairly well defined cross-inoculation groups of plants."

Then he goes on to explain.

> "Rhizobium meliloti will infect alfalfa and white or yellow sweet clovers."

Now, that is the cross-inoculation group that Captain Greer referred to as the alpha group, but that also does inoculate white or yellow sweet clovers. Now you come to Rhizobium trifolii, which is the one mentioned in the claim that we talked about, claim 1. This will infect red, white, crimson or mammoth clovers.

Now, in that cross-inoculation group we have got those four plants. Then you go to the others. Rhizobium leguminosarum will infect garden or field peas, vetch,

216 and broad beans. And then the next group is Rhizobium phaseoli, which will infect garden or field beans. Then comes Rhizobium lupini, which will infect the lupines; and Rhizobium japonicum will infect the soy beans.

So here we have got six cross-inoculation groups. Practically each one of them has a number of various plants to which it is specific and the seeds of which it will infect.

The Court: Yes. All right, we will take a short recess.

217 (Whereupon a short recess was taken.)

Mr. Thiess: Q. Now, Mr. Bond, have you another photograph that you can produce, which shows these effects?

A. I have a photograph of three groups of soy bean plants, eight plants in each group.

Mr. Thiess: I would like to have this photograph marked for identification as Plaintiff's Exhibit Number 15.

(Said photograph was thereupon marked as Plaintiff's Exhibit No. 15 for identification.)

Mr. Thiess: Q. Now, will you describe what that photograph shows?

A. The photograph is of soybean plants, three groups of soybean plants, with eight plants in each group.

The first group are plants obtained from a pot, to which no bacteria were added. It is an uninoculated control, one of the uninoculated control products.

The second group was inoculated with strains 95 and 96, unmixed with any other bacteria.

The third group was inoculated with the same strains 95 and 96, mixed with other species.

The other species were alfalfa and clover. In this
218 case there is no real difference—there is no real apparent difference between the two groups of plants, that is, the groups on the far right, the leaves are bunched up a little and it does look a little smaller, but there is no appreciable obvious difference there; the height of the plants are approximately the same, but on an analysis, by means of the efficiency test as shown in Exhibit 5, there was a substantial reduction in yield in the third group.

These pictures show that even though there may be a 20 per cent difference in the growth of the plants, visual observation is a very inaccurate method of determining this difference.

The only way the difference can be detected with any assurance of accuracy is to conduct an efficiency test and actually analyze the plants for their dry weights and for their milligrams of nitrogen contained in those plants.

Mr. Thiess: I would now like to offer in evidence, if Your Honor please, Plaintiff's Exhibits 14 and 15, which have been marked for identification.

The Court: They may be received in evidence.

219 (The photograph headed "Clover" and showing in the upper right hand corner thereof "40 PLANTS EACH GROUP", so offered and received in evidence, was marked Plaintiff's Exhibit No. 14.)

(The photograph headed "SOY BEANS, 8 PLANTS EACH GROUP", so offered and received in evidence, was marked as Plaintiff's Exhibit No. 15.)

Mr. Thiess: I now wish to refer you again to the chart which has been offered in evidence as Plaintiff's

Exhibit 10, Effect of Inhibition in Mixed Culture, which you started to describe yesterday and which we did not complete, and I wish you would start right at the beginning and describe what that exhibit shows.

A. Figure 1 represents greenhouse pot test of an inhibitive strain of bacteria.

The vertical columns represent the total amount of nitrogen found in plants, uninoculated plants, plants inoculated with the single culture, that is, strains unmixed with any other species.

The third column represents this same strain, mixed with other species of bacteria.

This inhibited strain showed a loss, due to inhibition indicated by the difference between the single and the mixed columns.

Translating that into field results, Figure 3 shows
220 a typical number of bales of hay that would be obtained through the use of a culture containing these same inhibitive strains. When used alone, it produced a good yield. When used in mixture, there was a definite loss due to this inhibition.

Figure 2 shows greenhouse results obtained as a noninhibitive strain of bacteria when used single and when used mixed.

The first column again represents a total nitrogen found in uninoculated control.

The second column represents a total nitrogen found when the noninhibitive strains are used alone.

The third column shows the total amount of nitrogen found when these same noninhibitive strains were mixed with other strains. In this case, no loss was observed, due to the mixing, due to the association of this culture with the other species.

Translating this into field results, we have Figure 4, which shows that there is no loss—there is no difference in using these noninhibitive strains in single culture or in mixed culture.

These results are merely typical. They are not taken
from any definite data. It shows a typical result
221 obtained with inhibitive strains or with noninhibitive strains.

Mr. Thiess: Q. I now wish to call your attention to a drawing that you made, showing the reduction in yield in red clover due to inhibition, and I would like to have

this drawing marked for identification as Plaintiff's Exhibit Number 16.

(Said chart entitled "Reduction in Yield of Red Clover Due to Inhibition" was thereupon marked Plaintiff's Exhibit Number 16 for identification.)

Mr. Thiess: Q. (Continuing) Now, will you describe what this drawing illustrates?

A. These two charts illustrate the differences due to the inhibition, taken from actual experimental data.

The chart on the left hand side is taken from data from our own tests, and the single clover culture—strains of clover used alone yielded 8.93 grams dry weight over the uninoculated controls.

These same strains of clover, when mixed with alfalfa and soybeans, yielded only 7.30 grams, increased 222 grams dry weight over the uninoculated controls.

There is a 18.2 per cent loss here due to the inhibitive effect of the alfalfa and soybean bacteria on the clover organisms.

The chart on the right hand side illustrates actual data taken from Max Kronberger's paper which was previously introduced.

The first column showed an increase of 9.26 grams dry weight over the uninoculated controls.

The second column showed an increase, which was inoculated with the same clover strain, mixed with alfalfa bacteria, showing an increase of 6.96 grams dry weight over the uninoculated controls.

In this case, 24.8 per cent loss was obtained due to inhibition, that is, inhibition of the alfalfa organisms in the culture.

The Court: Q. Does the 18.2 per cent loss in your own experiment indicate that it is not desirable to use that combination?

A. No. If these clover strains were used in a mixed inoculant, with alfalfa and soybeans, such as you have here on the table, that inoculant would not produce the yield that these same strains would have in a single 223 culture.

The Court: Q. I understand, but is that a sufficient percentage as to cause you not to use it?

A. Yes.

Mr. Thiess: I would like to offer this drawing as Plaintiff's Exhibit 16.

The Court: It may be received.

(Said paper showing two charts appearing under the general heading "Reduction in Yield of Red Clover Due to Inhibition", so offered and received in evidence, was marked as Plaintiff's Exhibit Number 16.)

The Witness: In explanation these are just the dry weight determinations. The percentage of nitrogen of the lower yield, that is of the mixed culture in this particular experiment, was less. So when it was based there, on the difference in the milligrams of the nitrogen, the protein content of the plant, there was a larger difference than just 18.2 per cent. This chart just indicated the dry weights.

Mr. Thiess: Q. Now, I have referred to this heretofore, but I would like to have Mr. Bond refer to the
224 patent, page 5, column 1, lines 36 to 38, at which point the patent refers to noninhibitive strains of the organisms by the term "alpha", and I wish you would please state in what manner this term alpha was used in your patent specification and claims.

A. Alpha is used to designate strains of root nodule bacteria. They are mutually non-inhibitive in a mixed culture. It is an arbitrary designation to simplify the reference to these noninhibitive strains.

Q. Then, whenever the term alpha is used to modify a species of bacteria, in your patent, it refers to a mutually noninhibitive strain, is that correct?

A. That is correct.

The Court: Q. That is something that you used, rather than something adopted by the trade?

A. Yes, that is right. The term alpha, in its application here to the specification—

The Court: Is your own?

A. (Continuing:) —is my own designation. It is not necessarily accepted by the field. As I understand it, it is a common practice in patents of a bacteriological nature to assign terminology of this nature to certain types of organisms that are being discussed in the patent, whether it deals with root nodule bacteria or
225 deals with bacteria of other kinds.

Mr. Thiess: In other words, the patentee is making his own dictionary.

The Court: Yes.

Mr. Thiess: Q. Now, merely so that we may have it for the record, will you refer to the patent, page 5, column 2, beginning at line 32 and the matter that follows; does that describe the manner in which the mixed inoculant is prepared?

A. Yes, from line 32 down through line 72 is a description of a method for preparing a mixed culture.

Q. And that is the one that you referred to and is depicted in Plaintiff's Exhibit 7?

A. The Exhibit 7 does not demonstrate the method of making a mixed culture. It demonstrates a method of preparing bacteria suspension that can be used to make a mixed culture.

Mr. Thiess: That is it.

Q. Will you just briefly refer to the manner in which you make that, without going into it in too much detail, because it is all set out in the patent?

A. I would like to refer again to Exhibit 9— is 226 that correct?

Mr. Thiess: 7.

The Witness: 7? It is marked 9 on this.

Mr. Thiess: What have you there?

The Witness: The same one.

Mr. Thiess: Yes, that is 7.

The Witness: A. The start of the preparation of a mixed culture is the same as the start for the preparation of a single type culture which is demonstrated in this chart. The same steps are followed as with the test tube stock strain 1. Taking for example, a mixed group containing three different species, which will inoculate three different cross-inoculation groups, we start out with at least three different stock test tube strains, stock strains and test tubes, and each one of these is run through the same procedure down to the point where the bacterial suspension is obtained in container 6.

The Court: I thought you explained this yesterday?

Mr. Thiess: He did.

The Witness: I did, but I was just explaining that it was used in a mixed culture.

This is an illustration of a preparation of single 227 culture here, but it is identical in that point, except we make three different bacterial suspensions we get 3 6s in other words, and those three different containers containing three different suspensions are checked in the laboratory to predetermine the number of organisms pres-

ent in each, and a volume of each is calculated so that the organisms will be added to the mixer 8, in the proper proportion, and from there on it is simple—adding the different suspensions together in the mixture and thoroughly stirring the whole mass and discharging it over again into the drum 9, and ultimately it is packaged into the finished product 10. In other words, the same procedure is used except that there are three different cans of bacterial suspension 6, instead of just one, and they start out with three different stock strains 1.

Q. This mixer is something that you revolve?

A. It is a mechanical mixer that thoroughly incorporates the bacterial suspension into the humus.

Mr. Thiess: Q. Now, Mr. Bond, will you state, what are the advantages that flow from the use of a mixed culture of the type described in your patent, and I refer you particularly to your patent, page 2, column 2, beginning at line 8?

228 A. Beginning at line 8 is a discussion of the advantages of the composite inoculant over that of a single inoculant, from the point of distribution. These cultures are sold by the manufacturer to seed jobbers or distributors. They in turn sell the product to retail dealers, and the retail dealers in turn sell the product to the farmer.

Each container has an expiration date stamped on it, and after that expiration date, the cultures are returned, through that sequence, to the manufacturer; that is; any cultures that the dealer has left on hand are returned to the distributor, or any cultures that the distributor accumulates from the dealers or that he has on hand are returned again to the manufacturer.

Previous to the past few years, all manufacturers allowed 100 per cent on those returns, that is, they were replaced the following year without charge, to insure the dealers having only fresh cultures.

In the last few years, restrictions have been imposed on that, in that only 50 per cent is now allowed to the dealer and to the distributor down to the manufacturer.

229 But the important correlation is this: With separate packages for each different culture and each of these packages being offered in several sizes, there is an accumulation of stock that is very difficult to follow through on, that is, is very easy for a dealer to get stuck,

we will say, at the end of the season, with too much alfalfa inoculation or too much red clover inoculation, and, he ordered enough, to the best of his knowledge, to supply his demand for that particular season, and if the season was unsuitable for planting at the proper time, maybe the amount of seed in this particular territory that year planted would be reduced and he would be left with a lot of surplus on hand.

By combining the culture, by combining alfalfa with clover, they were able to carry a smaller stock and still be able to supply an ample amount of inoculation for either clover or alfalfa. It was better exemplified by the use of a container containing three different units. It reduced the amount of stock that each of them had to handle and the different types of stocks. The seed inoculants are a side line to the seed trade proper and it does produce difficulties in trying to keep track of all these different sizes and all the different cultures,
230 and any simplification along those lines has very distinct value.

The Court: Q. Is the product returned to the manufacturer re-used?

A. Product returned to the manufacturer is destroyed.

Mr. Thiess: Q. Prior to the time of your invention, did the Kalo Inoculant Company sell single cultures for each of the plants, clover and alfalfa?

A. Yes.

Q. And since your invention, have you sold these single cultures, or at the present time do you?

A. No. We do not offer the single cultures at the present time, because we have no demand for them.

Mr. Greer: Because of what? I did not get that last part.

The Witness: We have no demand for the culture—for the single, individual cultures, that is for clover and alfalfa.

Mr. Thiess: That is it.

The Witness: We do have a demand for soybeans, Austrian winter peas and some of the other cultures.

Mr. Thiess: Q. But you also have a demand for the mixed cultures of soybean, alfalfa and clover cultures?

231 A. That is true.

Q. Now, in your patent, page 1, line 12, you refer to "symbiotic relationship." Will you please state what is meant by that?

A. A symbiotic relationship is a mutually beneficial relationship and in this particular case—

Mr. Thiess: Just a minute. Your Honor, commencing in line 10, the patentee says, "but it has been known for a number of years that it can only be carried out when the plant grows in symbiotic relationship with certain bacteria of the genus Rhizobia."

Now, I am asking him to define what symbiotic means. Now, Mr. Bond, start over again.

A. Symbiotic relationship is a mutually beneficial relationship. In this case, the plant supplies the bacteria with a home and food to grow on, and in turn the bacteria supplies the plant with fixed nitrogen compound.

Mr. Thiess: Q. Now, referring to your patent, page 2, the second paragraph, column 1— I will change that. It is the first complete paragraph, where you refer to the term "viable strains." You say, "These cultures have appeared in a large variety of forms and contain
232 a large number of viable strains of the desired organism." What do you mean by the term "viable strains"?

A. Viable strains are living strains.

Q. Now, on page 3, column 1, line 61 of your patent, you refer to "aerobic" and you say, "may readily develop under aerobic conditions. What is meant by that?

A. Aerobic means in the presence of air. The Rhizobia require air for their multiplication of growth.

Q. Now, in your patent, on page 2, beginning at line 25, column 2, you refer to "pasture mixtures". Will you kindly tell us what is meant by this expression?

A. A "pasture mixture" of seeds is one that comprises a mixture of seeds including different species of leguminous plants and non-leguminous grasses. In the past, where one of these "pasture mixtures" contained seeds from two or more cross-inoculation groups, it was necessary for the farmer to buy two packages of inoculations if he wanted to inoculate that group, that is, if it contained, for example, clover and alfalfa seeds, in this "pasture mixture", you would have to buy a can of clover and a can of alfalfa inoculant, if he wanted to inoculate that mixture. The use of a composite culture would eliminate that need and he would only have to
233 purchase one package, to inoculate his "pasture mixture". This is a minor point so far as the ad-

vantages of composite cultures are concerned, that is, pasture mixtures are not widely used, but still it is a fact that it is one of the advantages of a composite culture.

The Court: Q. That would only be an efficient mixture with respect to the leguminous plants?

A. It would if there are two or more groups. It won't hurt if the grasses are in it, it won't hurt the grass seed, but it won't benefit the grass seed either, but, if in that mixture there were in addition to the grasses two or more groups of alfalfa or of different seeds that represent different cross-inoculation groups, it would be necessary to either employ two single cultures or one composite culture.

Mr. Thiess: Q. Now, referring to the method of preparing the inoculant described on page 3, column 1, line 14 of your patent, was that the common practice well known in the art of bacteriology, at the time you filed your patent application?

A. Yes. This practice was well known.

Q. Now, in your patent, at page 4, column 1, beginning at line 29, you refer to the "Petroff-Hausser bac-
234 terial counter or other suitable direct counting apparatus." To what extent is such a counter used and what is its degree of accuracy in this art? First, you might say what it is used for, and then answer the other.

A. The Petroff-Hausser counter is used to estimate the number of organisms in a liquid suspension and the counter proper is similar to a haemocytometer, that is, a blood counting chamber that is commonly used in medicine and it is used under a microscope and to actually count the number of organisms in squares of liquid. The accuracy of the counter varies with the operator and to the extent of the number of squares that are being counted and the number of samples that are being taken, but it can be used within a 10 per cent accuracy.

Q. Is this count quite similar to the manner in which they count the corpuscles in blood?

A. Yes. It is the very same.

Q. And substantially just as accurate, is it?

A. Yes, it is. It is a smaller counter. It is made with greater precision and has to be used under a higher magnification of the microscope. The bacteria are much smaller than the blood cells.

Q. Now, the defendant in reply to our Requests for
235 Admissions admitted that legume inoculants are applied to legume seeds prior to planting, as you have testified, but the defendant qualified this admission by stating "that the legume inoculants may be applied to the soil as well as to the seeds." What have you to say about this qualifying statement?

A. It could be applied to the soil, but it would be a very unreasonable procedure and I don't believe any of the legume inoculants are applied in that manner. You would have a problem of applying a can of inoculant of that size, which is sufficient for one bushel of clover or alfalfa, and one bushel of clover or alfalfa normally plants between four and five acres, and the cans contain about six ounces each. To spread six ounces over four or five acres with a can of this size, is a very improbable procedure.

Q. Now, in response to our Requests that the defendant admit that immediately thereafter "root nodule bacteria specific to one cross-inoculation group will not inoculate the leguminous plants of a different cross-inoculation group" defendant stated that it could not agree with the statement, and that "a strain or variety of root nodule bacteria may occasionally under ordinary conditions and frequently under special conditions produce
236 nodules on plants different from those it usually inoculates, or it may lose the ability to produce nodules altogether. So little is known as to the exact causes of nodule formation and so many unknown reactions occur it cannot be positively stated that root nodule bacteria specific to one cross-inoculation group will not inoculate the leguminous plants of a different cross-inoculation group under all circumstances." What have you to say as to that statement?

A. The statement is correct insofar as it says "under all circumstances." There has been extensive work done in recent years that indicates cross-inoculation in wild leguminous plants. Bacteria isolated from the wild legumes are to a certain amount capable of this cross-inoculation between cross-inoculation groups. But with the cultivated leguminous plants, to which inoculation is being applied, there are very few examples of exceptions to the rule. It is true of any biological phenomenae so far as cross-inoculating— By that they mean that alfalfa legume bacteria might cross-inoculate with red clover plants

or soybean plants, and there is evidence in the literature that occasionally such a thing might take place, but the whole foundation of the inoculant business is based
237 on the different species which are used for different plants. There would be no point in offering a culture for soybeans and another one for peas, if we could use the same one for all of them.

Q. Now, in response to request that the defendant admit the truth of the statement "that there is a variation between strains of root nodule bacteria of the same species with regard to their nitrogen fixing efficiency or their ability to benefit the host plant for which they are specific", defendant says "there are all degrees of variation from high or best nitrogen fixing strains, medium or good strains or low and poor nitrogen fixing strains but this nitrogen fixing characteristic is not constant as to any strain. In other words, one strain at one time may possess the highest or best nitrogen fixing characteristic but on the next application may drop to the lowest or may lose its nitrogen fixing characteristic altogether and then after a lapse of time may repossess such characteristic." What have you to say as to the practical importance of the matter contained in that quotation?

A. Well, again, the whole foundation of the legume inoculant business is based on the selection of highly efficient, good strains, and under proper conditions
238 they can be maintained, their level of efficiency can be maintained.

It is true that occasionally, again, an odd strain will apparently change, for no good reason, but the frequency of such an occurrence is very small.

Now, it is also true that the nitrogen fixing ability of these strains can be altered deliberately by special treatment, that is, they are altered by what is known as plant passage, by inoculating a plant forming nodules on it and separating the bacteria from those nodules and comparing it with the original culture. That culture may be changed with respect to its nitrogen fixing characteristic. It may be changed down or it may be changed up. The efficiency of the bacteria—the nitrogen fixing characteristic of the bacteria—will be affected just as it may be affected when two types of species are mixed together.

There are other examples that may affect this nitrogen characteristic—that may change this nitrogen fixing characteristic of the organisms. The addition of glycine, one

of the components of gelatin, reduces the efficiency of the bacteria.

239 In the presence of hydrogen, the efficiency of the bacteria is reduced, or in the presence of carbon monoxide, the efficiency of the plant bacteria complex is reduced; and there are other examples I find from the literature.

It is true that this nitrogen fixing characteristic can be changed, but it is also true that experiences have shown that strains can be maintained over periods of 20 years or more. With an artificial media of the proper composition, the strains will maintain their high efficiency and can be used with confidence in the preparation of commercial cultures.

240 Q. Mr. Bond, in your opinion as an expert in this art, in order to assure or insure against inhibition when mixing the strains of various species of bacteria when used for legumes, is it necessary to select a strain that is not inhibited if you want to be positive that the ultimate culture will give the maximum efficient result?

A. The only way one can be sure the finished culture will produce maximum results is to test the individual strains in the mixture against themselves; that is, compare the results obtained with each strain with the same strains in the mixture.

Q. Do you believe as an expert in this art that one can select efficient strains of bacteria for alfalfa and clover at random and mix them in a composite culture and be sure that the composite culture would not produce inhibition between the two strains of bacteria?

A. Well, there would be no way of being sure that random selection of strains, that there would be no inhibitive strains in the mixture. By accident non-inhibitive strains, which we have demonstrated do exist, might be selected but there would be no way of knowing until the culture had been tested by means of an efficiency test.

Q. Now, were there any other problems aside from the matter of inhibition involved in the production of a

241 satisfactory mixed culture for field legumes?

A. Well, evidence from the literature indicated that there was a second problem involved, namely, the presence of sufficient organisms of the proper type to form an ample number of nodules in the respective host plants for which the culture is to be recommended.

Q. And how did you solve that problem? And here I refer you particularly to your patent, Page 4, Column 1, beginning at Line 25.

A. Beginning at Line 25 there is a discussion of the method of predetermining the number of bacteria to be added to the mixed culture and, previous to that, the specification discloses a method of preparing the culture in such a way there would be a minimum amount of nutrient materials added to the final product.

Q. And what is the number of organisms that are contained in this culture prior to the time it is mixed with the humus or carrying agent?

A. Well, sufficient organisms are added in the first place that subsequent growth in the humus is unnecessary; that is, there are sufficient organisms in the culture and mixed with the humus to thoroughly inoculate the seeds without any subsequent growth.

242 Q. Will you now please sum up the various factors involved in the production of a satisfactory mixed culture for field legumes and the manner in which your patent insures such satisfactory mixed culture?

A. Well, there were two problems to be met in the preparation of the satisfactory mixed culture. The first was the preparation of the culture in such a way that sufficient bacteria would be present at any time within the limits of the expiration date on the container to form an ample number of nodules on the roots of the different host plants for which it was employed.

The second problem was the use of strains of different species that would not be inhibited when mixed together. In other words, the culture must contain only good efficient strains to produce maximum beneficial results when used under field conditions.

The Bond patent discloses a product which satisfies both these demands, both these problems. The first problem is solved by using a large number of organisms of substantially the same order of magnitude in a base containing a minimum amount of the nutrients to retard subsequent growth in that base.

The second problem was met by testing the strains
243 singly and mixed to be sure no inhibition would take place when these strains were mixed together.

Q. Can you state why you keep the nutrients in this medium down to a minimum?

A. The multiplication rates or growth rates varies

between different species and even between strains of the same species and, after the addition of the bacteria to the culture, to the humus, there is a following growth in spite of the fact that a minimum amount of nutrients is used and in that culture period, if one organism has a substantially higher rate of growth over the other, it would predominate over the other and the second strain would not be there in sufficient numbers after storage to thoroughly do the job it is supposed to do.

The nutrients also affect the life of the organisms in this manner. It is a common precept of bacteriology that accelerated growth usually indicates an accelerated death rate. In other words, if they burn the candle at both ends, they are used up in a shorter period of time.

Mr. Thiess: That is all. Take the witness.

244 *Cross-Examination by Mr. Greer.*

Q. Mr. Bond, let's go back a little bit to the beginning of your testimony. I would like to know, first, exactly what your age is.

A. My age?

Q. Yes.

A. I am thirty-three.

Q. And, as I understood you in your direct examination, your educational experience in connection with this art of bacteria pathology or bacteriology was that you graduated or obtained a Bachelor of Science degree, was it—

A. Yes.

Q. (Continuing) —at the University of Wisconsin and then later a Master's degree at the University of Wisconsin?

A. Yes.

Q. And what years were those degrees conferred upon you?

A. The Bachelor of Science degree in February 1934 and the Master of Science degree in June 1936.

Q. 1936. Now, immediately after that you went to the Earp Thomas Laboratories, Incorporated, and were employed there for a while, were you not?

245 A. No, I was never employed by Earp-Thomas.

Q. But you were there?

A. I was in the Earp-Thomas Laboratory, that is correct.

Q. What were you doing there?

A. I was trying to find Doctor Earp-Thomas most of the time. The Kalo Inoculant Company had been purchasing cultures from Doctor Earp-Thomas on a wholesale basis, mixing and packaging it at Quincy.

Q. He was engaged in the business of selling?

A. He was engaged in the manufacture. At the time I came with the Kalo Inoculant Company they wanted me to contact Doctor Earp-Thomas and, if he had any ideas of value on how to make a better culture, they wanted me to discuss the matter with him, if he had any better ideas.

It took me two weeks to find him and he had the worst laboratory I have ever been in and he had nothing to contribute at all. I think his product substantiates that, both on the product the Kalo purchased from him and his own product.

Q. The Kalo Inoculant Company did have a contract with him, did they not?

A. That is right.

Q. For using his cultures?

246 A. That is correct.

Q. The Kalo Inoculant was the exclusive distributing agent for the Earp-Thomas Laboratories' cultures, were they not?

A. Yes. I don't recall for what period of time that was in effect. When I came with the Kalo Inoculant Company I did not use any of his cultures or any of his methods.

Q. Was that contract in existence at that time?

A. Yes, it was in existence.

Q. How long, approximately, did it continue after you came with the Kalo Company?

A. I don't know how long but we used none of his cultures but used solely Humogerm, the trade name Humogerm.

Q. Did you use the trade name Farmogerm also?

A. Not after I came with the company. Previous to the time I came with the Kalo Inoculant Company I am not familiar with the cultures they used or the plant materials but to the best of my knowledge the Kalo Inoculant Company never sold any Farmogerm.

Q. Were you familiar at all with their advertising matter at the time you came there or shortly after you came there?

A. Not with respect to Farmogerm. I was with regard to Humogerm. They were not selling Farmogerm at the time I entered their employ.

247 Q. The Kalo Inoculant Company wasn't?

A. The Kalo Inoculant Company wasn't.

Q. Do you know whether or not the Thomas Company was selling it?

A. I do not know at that time.

Q. You know back in 1933 and 1934 that there had been on the market this composite culture that was sold under the trade name of All Crop Farmogerm?

A. That is right. There were several all crop cultures on the market previous to that time.

Q. Well, the Earp-Thomas Laboratories had the trade name of All Crop Farmogerm they used, did they not?

A. Yes, I knew that.

Q. Did you ever see any of those cultures?

A. No, I never saw one.

Q. But that was long before 1938 you knew it had been on the market?

A. I knew it had been on the market, yes.

Q. Well, now, that was when, when your were with the Earp-Thomas Laboratories? That is when you were there doing this research work?

Mr. Neuman: You are misstating the witness' testimony. He did not state that.

248 The Witness: I was trying to find Doctor Earp-Thomas most of the time.

Mr. Greer: Q. What were you doing the other time?

A. I enjoyed New York City and finally traced him down to Boston. I located him at his hotel there. He was supervising a garbage disposal plant and a fish waste plant and I had the opportunity to talk to Doctor Earp-Thomas at that time and, so far as any valuable information with respect to inoculants at that time, there was absolutely nothing to learn.

Q. Did you see any inoculants being prepared at all in his laboratory there?

A. I was in his laboratory and they were preparing a milk culture that was supposed to cure everything from cancer to hives. They did have some legume culture in bottles. The only way they prepared it was to transfer it from a test tube to an agar slant, a procedure familiar to anyone in the art. So far as learning anything, I did

not see a thing there. I believe I could substantiate that from other people who have been in his laboratory.

Q. Then after that you were employed by the Agricultural Laboratories, Incorporated, were you not?

A. I was employed by the Agricultural Laboratories, Incorporated? Well, let's see. I don't know whether
249 you would call it employed by them or not. I had agreed to work with the Agricultural Laboratories, Incorporated.

Q. You had what?

A. Agreed to work with them and I had accepted an expense check from them. That is the extent I worked for the Agricultural Laboratories.

Q. You were not paid a salary at all?

A. I was paid no salary whatever.

Q. How long was the trip?

A. The trip amounted to a few days.

Q. How long?

A. A few days.

Q. What was the purpose of it? What did you do?

A. The Agricultural Laboratories were interested in employing me at that time and after that summer they introdnced this mixed inoculant. At the time I was discussing things with them I hadn't any idea they were interested in a mixed inoculant.

Q. You were there only two days?

A. I don't recall the exact number of days. It was four years ago and I may have been there longer or shorter. Whatever it was, I was just discussing things
250 with Mr. Elmer. There was no research work or anything else.

Q. That was in 1941?

A. That was in 1941.

Q. At that time then you were enjoying your regular salary from the Kalo Inoculant Company?

A. That is correct.

Q. You were their employe when you went down to the Agricultural Laboratories?

A. That is correct.

Q. Now, let's get into this bacteria field for a little while. As I understand the technical terms, the general family of bacteria that is applicable to leguminous plants has this name Rhizobia.

A. The genus has the name Rhizobia.

Q. I said the general family; that is the same thing as genus?

A. The genus comes under another family biologically.

Q. And it is a form of life that is called bacteria?

A. That is correct.

Q. And nature provides that life?

A. That is correct.

Q. And that bacteria or life which is found in na-
251 ture, as stated in your patent at Line 43, I believe it is, that I am quoting—

A. What page?

Q. Beginning at Line 43 on Page 1.

Mr. Thiess: What column?

Mr. Greer: Column 1.

Q. (Continuing) —where you state:

"Bacteria of the genus Rhizobia which are capable of infecting leguminous plants so that nitrogen may be fixed are widely spread in nature."

Now, that is a universally accepted fact among scientists, is it not?

A. That is correct.

Q. Now, you also say in that same column on the same page beginning at Line 9 that

"The mechanism of this nitrogen fixation is not understood at the present time, but it has been known for a number of years that it can only be carried out when the plant grows in symbiotic relationship with certain bacteria of the genus Rhizobia."

That, likewise, is an accepted fact among scientists,
252 is it not?

In other words, my point is this, that the Rhizobia of itself, that is this bacteria, in and of itself does not fix any nitrogen or take any nitrogen from the air. It has to be in association with the roots of a leguminous plant. There has to be that corroborative action between the two, the Rhizobia and the roots of the plant, is that correct?

A. That is correct.

Q. And that is what you mean by symbiotic relationship?

A. Yes.

Q. If the bacteria does not have this affiliation with the fibrous condition of the roots of the plant it is not symbiotic. If it does have it, there is a symbiotic relationship, is that correct?

A. That is correct.

Q. And the bacteria in order to function at all in this nitrogen fixation characteristic must enter the fibers of those roots?

A. That is correct.

Q. Now, would you take the position that this fibrous condition—maybe I am not using the technical language but I think you understand what I mean—that the fibrous condition of the roots of leguminous plants is not
253 always the same, even in the same species of plant?

A. You mean by the composition of the roots?

Q. Well, you might call it chemical composition or—I will put it this way: One bacteria, which we will regard as just one little bug, for instance,—

A. Yes.

Q. (Continuing) —may be able to do it in the fibrous condition of one root of, we will say, an alfalfa plant, but another bacteria might not be, or we will say that the same bug or same condition might not be able to enter the root of another alfalfa plant?

A. Well, there is no direct correlation between the number of bacteria applied to the root and the number of nodules formed.

Q. Well, you will not have the nodule formation unless the bacteria gets into the root?

A. Correct.

Q. What I am trying to get at is, there is a relationship between this symbiotic relationship. You don't always get the same infection by using the same specie of bacteria with the same specie of plant?

A. There are physical conditions of environment that will affect either one or both.

254 Q. Well, that means then that about all we know about it, from the standpoint of actual knowledge, is that when you bring the two into relationship, the bacteria and the plant, sometimes you are going to have nodule formation and nitrogen absorption from the atmosphere which we will call nitrogen fixation, sometimes you are going to have it and sometimes you do not have it?

A. Under identical conditions with the same plant and the same strains of bacteria prepared in the same way, there is every confidence that if the nodules are obtained in one case you would get them in the second.

Q. Wouldn't the mere location of the pot on the shelf in the laboratory bring about a variation?

A. That is true. Then you don't have the same conditions. You may have less light. The physical environment can influence the production of the plant.

Q. Even if the pots are in the same room on the same shelf?

A. Planted with the same seed.

Q. The same kind of seed. It can't be the same seed.

A. With the same batch.

Q. Out of the same batch?

A. Yes.

255 Q. And you wouldn't necessarily get the same nitrogen fixation result. You might or you might not is all I am trying to get.

A. Well, there is an inherent variation that there is there, but to say you would not get nodules formed in one case and you would in the other, is a very extreme case; the probability is very small.

Q. You take, for instance, the color of the seed itself might have some influence?

A. Yes; there is a different variation between pots in a series, all of which have been presumably treated in the same way.

Q. And those variations or differences are brought about by nature. You don't know exactly why they happen; they just simply happen.

A. That is true and experimental errors are introduced by the operator, inadvertently.

Mr. Greer: Now, I would like to, for a moment, look at these two plants that you had in here yesterday. I think they are in the other part of the room. (Counsel produces two pots of plants.)

Q. (By Mr. Greer) We will assume that these two plants are in the same condition that they were in
256 yesterday. One of them seems to have wilted considerably more than the other one overnight. As I understood you, these are soybean plants?

A. Yes, sir.

Q. And the one which is of shorter growth was not inoculated with any bacteria at all?

A. That is right.

Q. And the one that has the greater growth and development was inoculated but you do not know whether it was inoculated with a single strain of japonicum, or soybean bacteria, or a mixture, as I understood your testimony yesterday.

A. Yes; that is because I haven't checked the number. I can go back to the laboratory and tell you what it was inoculated with. It is number 12-4.

Q. It doesn't make any difference. You can't tell from looking at it.

A. I can't tell from the plant what was added to it but I can tell from my records what was added to it.

Q. It was inoculated with either a single strain or a mixed strain.

A. I believe this was single strain. The last ex-
257 periment was almost all single strains.

Q. My point is: You can, from just visually looking at it,—I think I can, and I am not posing to be an expert or one skilled in this art,—you can, from a visual examination of a comparison of these plants, tell that the plant which is inoculated, is tremendously benefited over the plant which was not inoculated.

A. Yes; in this case there is no question about it.

Q. As a matter of fact, you could approximate the percentage of nitrogen fixation, couldn't you? I don't mean that you would be exactly accurate in it but one skilled in the art, from just a visual examination of two plants in comparison, could make a pretty good guess as to the extent of the nitrogen fixation?

A. You could make a pretty good guess within approximately 20% to 25%. When you narrow down your percentage less than that, it is very difficult even for an experienced man, to detect differences, for sometimes they are greater than at others.

In the literature there are observations that when compared with actual amounts statistically, indicate that visual examination would give us an approximate estimate.

Q. That would be reliable to act on for commercial
258 purposes?

A. Yes.

Q. You could not determine, of course, the exact amount without going through this chemical analysis—

A. That is right.

Q. —and this statistical analysis, and all that. That would give you the exact amount of the difference; that is correct, isn't it?

A. That is correct; that is, within the limits of your experiment.

Q. That applies, then, to these two plants in which

you can visually, just by the eye, as you are skilled in the art, or even one unskilled in the art, could tell that that is a growth and development of the inoculated plant beneficial over the uninoculated plant?

A. That is correct.

Q. That means that there was greater nitrogen fixation in this inoculated plant than there was in the uninoculated one, is that right?

A. That is right.

Q. Now, that same thing would apply, would it not, Mr. Bond, with regard to a comparison between a single strain inoculation and a mixed strain inoculation; we will
259 say, for instance, that there is a difference in the appearance and that would be the case, would it not, either beneficial or deleterious?

A. Or deleterious.

Q. You could tell that by just visual examination?

A. You could tell it if it ran over 20% to 40%. If the difference was less, if it was within a smaller range, you might not detect that difference.

In a 20% difference in fields, with the millions of acres of beans, for example, which are inoculated with inoculation, it would make a very substantial difference in the ultimate yield.

That is, you may have two pots like that sitting side by side, and you look at them and you say they look about the same to me.

It is like this photograph we have here, of soybeans. There is a 20% difference here and looking at it, it is rather hard to find it. One is bunched up more than the other and is apparently smaller.

Q. Which exhibit are you looking at, Exhibit 15?

A. Yes.

Q. Wouldn't you say that that middle one which was the unmixed inoculation, showed a little better, I don't mean any appreciable—it shows a little better?

260 A. It looks a little better but here is also a problem involved here. This was one pot out of a series of five, I believe it was in this experiment, and you would have to sit there and compare each pot and you see those things varying up and down between each pot and to end up and to estimate that the average of five pots is better than the average of the other five pots, is a very difficult thing to do with any accuracy.

Q. But looking at every pot you can tell just by looks,

as you said yourself, and tell the variations between the pots themselves?

A. I don't believe that this picture here shows much variation between the pots.

Q. But it does show a variation?

A. The variation is very small.

Q. But it does show a variation, does it not?

A. It shows a very small variation, if any. It depends upon how you look at it. The plants on the far right are even higher than those in the center. The leaves are fluffed out more on the center ones, but the leaves are bunched up on the ones to the far right.

Q. That is a variation, isn't it?

A. It depends on how you detect it. If you said
261 that one on the right looks higher than the one on the left, and maybe there is more in it. I don't think this picture shows any distinct difference between those two.

Q. You won't say that it shows even a slight variation?

A. I would say the one on the right is slightly higher than the one on the left and the one on the left seems to have a little wider spread on it than the one on the right.

Q. If that difference is wider than that you could tell it by visual examination?

A. In some cases.

Q. Even without dry or wet weight comparisons?

A. Yes, in some cases you can. In other cases apparently plants are identical and on an analysis, particularly as far as the nitrogen is concerned, there is a very substantial difference between the yields.

Q. Now, in conducting laboratory experiments to determine this matter of the extent of nitrogen fixation by this relationship between bacteria and the host plant one thing that is necessary to be done in order to obtain a reliable result from your test is you place the soil in pots do you,—something like that?

A. Yes; those pots we use to grow them in.

262 Q. You plant the soil you want the seed of the plant to grow in in these pots?

A. Yes.

Q. And you sterilize the soil to get it free of any bacteria that would produce a deleterious effect on the growth of the seed you intend to put in it?

A. And the sand may contain nodule bacteria in it. You want no nodule bacteria in it.

Q. You want as near a pure medium that you are going to use as possible, and as a consequence you sterilize the soil you put in the pots?

A. Yes.

Q. What is the standard recognized method among bacteriologists that was in existence, we will say, at the time of your application for your patent, in 1938? There was a standard method of sterilizing these pots in that kind of a laboratory test, was there not, or an accepted standard?

A. Yes, that is right; anywhere from an hour up to 12 hours under 15 pounds steam pressure.

Q. Will you speak a little louder?

A. Anywhere from an hour up to 12 hours under 15 pounds pressure, resulting in an adequate sterilization of the sand.

Q. You would put it cold into an autoclave?

263 A. Yes.

Q. That is a kind of an oven that you put these pots in and what was the atmospheric pressure?

A. One atmosphere, that is 15 pounds.

Q. 15 pounds of pressure, and at what temperature?

A. That amounts to around 123 degrees Centigrade.

Q. And you would leave it in there for how long?

A. Well, in sterilizing the pots I sterilize them for an hour. That kills any of the legume organisms present.

Q. You wouldn't feel safe that you had killed the contaminating bugs that are in there, under an hour?

A. Oh, as far as feeling safe about it is concerned, all that is necessary is to heat it above 60 degrees Centigrade for ten minutes, and all the legume organisms will be killed.

There is a factor of penetration of the sand by the heat, and just as a safety precaution they are sterilized at a higher temperature over a longer period of time.

Q. You wouldn't get your higher penetration of the soil under this ten minutes. That is why you leave it in for an hour and sterilize the entire contents of the pot; not only the outside of it and the rim on the inside, but to get in the sand in the middle part?

264 A. The sand is sterilized by this standard method.

Q. And the accepted method was that you would leave it in there approximately an hour's time?

A. That is correct.

Q. In addition to this, your next step is the sterilization of the seed that you are going to test, is it not?

A. Yes.

Q. You don't take the raw seed and dump it in this soil?

A. No; the seed is sterilized by the accepted, standard method.

Q. What was, in 1938 the standard accepted method in the United States among bacteriologists and scientists and those skilled in this field—the accepted standard methods of sterilizing the seed you were using?

A. Different methods were used. The particular method that I used was a wetting of the seeds with alcohol and then soaking in 1% chlorine solution for 15 minutes.

Q. And that is a pretty generally accepted standard method?

A. That is correct.

Q. If you used too strong a caustic solution or something of that kind or left it there too long, you would injure the seed, would you not?

265 A. Yes.

Q. And that would have a deleterious effect on their germination in your test?

A. Yes.

Mr. Greer: May I look at chart, Exhibit 5? (Counsel hands Mr. Greer the exhibit.)

Q. (By Mr. Greer). Maybe it won't be necessary to go into this, in view of what my notes show you have stated, in answer to Mr. Thiess' question to you on direct examination, so I will ask you if I am correct in my impression on that: In the method of culture which is set forth in your patent in the culture of the single strain of bacteria, whether it is an alfalfa strain or a soybean or clover strain, you take the pure bacteria or strain of bacteria from what nature provides, as you said, scattered around here, and you isolated that, and then you put this through this method of cultivation for the purpose of multiplying the colony of the bacteria so that you can have a stock culture from which you can draw in selling it to your customers, and things of that kind, is that correct?

A. That is correct.

Q. And this method of the separate cultivation of these

strains that is set forth in your patent, as I under-
266 stood you to say, that method was one that was well-known in the art at the time of your application for your patent, in 1938?

A. Yes, essentially. There are some slight variations that are described in the specifications that I don't recall seeing before.

Q. Those variations would not, in any way, affect the character of the bacteria?

A. No; that is correct.

Q. When you get through with your culture you have the same bacteria you got from nature, but you have more of it, is that correct?

A. That is true; that is correct.

Q. And that was well-known in the art among those skilled in the art, prior to the date of your application for your patent or your claimed invention?

A. Yes, sir.

Mr. Greer: That won't make necessary for me, then, to use chart 5 any further.

267 In the District Court of the United States.

* * (Civil Action—No. Q-62) * *

Q. Mr. Bond, at the hour of adjournment at the
268 noon recess we had gotten down in the separate cultivation of your single strain where you have got that cultivated. Then, as I understand it, the next step in your process is to test that strain for its efficiency in nitrogen fixation, as shown on your illustrated chart, No. 5.

A. Yes.

Q. Now, that test, which in this chart is entitled "Efficiency Test for Nitrogen Fixation", that was a routine standard test well known in the art before your claimed invention, wasn't it?

A. Yes, sir.

Q. Now, in conducting such a test this chart just shows one pot, and that was meant for illustrative purposes. You would not base a scientific test on just the growth of one pot of a flower, or pots, would you?

A. No, the plants must be done in replicate. There is no way to statistically analyze the result unless there is at least one replicate of the pot in each series.

Q. So that this is just meant as illustrative?
A. Yes.
Q. And in the real test you would have a series of pots?
269 A. That is correct.
Q. Three or four, at least, or in all probability five, to make a standard number, isn't it?
A. It varies with the setup of the experiment.
Q. What?
A. It varies with the type of setup in the experiment you make. If an analysis of variance is used to determine the difference between the plants, it is unnecessary to have as many replicates in each series as when you just compare one series with another by means of statistical treatment.
Q. Well, I am comparing now the efficiency—
A. Yes.
Q. —of this bacteria in nitrogen fixation, and you would use a plurality of pots.
A. A plurality, more than one.
Q. More than one. And one of the purposes for that is that even in two pots there might be a variance of some kind?
A. Oh, yes, there is always a certain amount of variance in the series.
Q. That is the point, a certain amount of variance. You don't know why, it just simply happens, even
270 using the same strain under the same circumstances.
A. Yes, sir.
Q. There is this variance. Therefore, in order to have an accurate scientific test, you take a plurality of pots and then you strike the average?
A. That is correct.
Q. And that gives you what you consider your result as to your efficiency test. Now, all that is done. Then if you want the mixed culture, that brings us down, doesn't it, to your bacteria being in the container marked No. 6 on your illustrative chart, Plaintiff's Exhibit No. 7?
A. Yes.
Q. You have got your bacteria in here and you have tested them. You have taken them out of there, or taken some of them out of there, and subjected them to this efficiency test.
A. Well, the efficiency test is conducted on the stock strain 1 that we start with.

Q. Yes?

A. It is not necessary to subject that same strain to an efficiency test every time the culture is manufactured.

271 Q. No, I understand that.

A. The bacteria in stock strain 1 are tested, but those in the container 6 are essentially the same organisms.

Q. Yes. Now, if you were going to make your composite culture, you then have gone through that culture singly, of a clover strain. We will say we are going to mix clover and alfalfa. Now, you have gone through that with the clover strain. Then you go through the same process with the alfalfa strain?

A. Yes, sir.

Q. And then you put both the alfalfa strain and the clover strain in this humus base?

A. That is correct, according to the diagram.

Q. Yes, and in doing that you follow the same process that you would if it were a single inoculant, except that you put the two in?

A. That is right.

Q. And that was standard practice, that method of putting the bacteria into the base, the carrying medium, that was standard practice at the time of your invention?

A. The method of putting it in the medium was
272 standard practice, but it was not necessarily standard practice that the same method of growing the organism was used all the way through, nor was it necessarily standard practice to determine the number of organisms and to put in a larger number to insure inoculation without depending on additional growth in the base. That was not necessarily followed out in the preparation of single cultures. They can be made that way or they could be made this way.

Q. I don't know as I follow you exactly on that.

A. The single cultures can be satisfactorily prepared in several different ways. Single cultures have been prepared that have been satisfactory when all they did was to take a heap of this humus, moistened it, added sugars and mineral salts and all sorts of nitrogenous material to it, and then inoculated that mass with a small number of bacteria, a small bottleful, and then continually stirred it over and left it incubate for a number of weeks, and they ended up with a good culture, usually

did. Sometimes contaminating organisms overgrew the others but it was one method of preparing a culture which in my opinion did not give a reliable result in the
273 preparation of a mixed culture.

Q. Well, what I was getting at was, your method of putting it in. I am not talking about the numbers you put in.

A. Yes.

Q. But your method of putting it in the carrying medium was a standard method.

A. Essentially the same.

Q. That you don't claim any invention of yours.

A. Oh, no, there was no invention.

Q. This carrying medium or base was a well known base, too, was it not?

A. Yes, the humus base was familiar to the art.

Q. That was known prior to your claimed invention in this patent?

A. Yes.

Q. Now, that humus base has some nutrient value in it, has it not, that the bugs can feed on?

A. The humus base does contain some amount of nutrients. However, the availability of those nutrients to legume organisms is a pretty uncertain thing. That is, the humus do contain, if I recall correct, the analysis, around two or three per cent nitrogen. Well, that
274 would seem to indicate that it was fairly rich in nitrogen. Yet this humus is not digestible as a feed. Sometimes it is used as a filler in feeds, and when it is so used the nitrogen container is of no value to animals. Now, animals are able to digest nitrogen compounds that the bacteria can't touch.

Q. Now, then, after these bacteria are in this container where they have been taken, where the solution is put in this container,—they are in a solution form there, are they not?

A. They are in suspension.

Q. Suspension form. And there is bacteria and nutrient matter in that solution suspension, too, isn't there?

A. There is. They are carried over from the media on which they originally grew.

Q. And that is what you put in the humus?

A. That goes into the humus.

Q. Now, do I understand you correctly, that when you have thus prepared this preparation, whether it is a

single culture or the combination culture by putting the two single cultures or more, if you want to, in the humus base, and we get this package here, which is the com-
275 bination culture, which you sell under the trade name of uni-culture,—do I understand that after it is then packaged that you no longer have any growth of the bacteria in there, any increase in its numbers at all?

A. No, the bacteria increase after they have been added to the humus.

Q. After it is packaged, that is?

A. After it is packaged. There is a subsequent growth.

Q. Well, then that means that there must be some nutrient material for them to feed on there?

A. Yes. Well, the legume organisms will grow on a very low nutrient medium.

Q. I did not understand that.

A. The legume bacteria will grow on a very low nutrient medium.

Q. Yes, but they won't grow unless there is some nutrient material there.

A. No, some nutrient material must be there.

Q. That is correct. Now, just one other point on that feature. Do I understand you to say in your direct examination that after you have once tested a strain, whether it be a clover strain or an alfalfa strain or
276 a soy bean strain of bacteria, and as a result of that test you find that it is a high nitrogen fixer,—do I understand your direct testimony to be that it remains constantly a high nitrogen fixer throughout a period of twenty years, we will say?

A. There are definite cultures that have been maintained for that period of time and have been frequently tested within that interval and have maintained their efficiency over that period.

Q. Well, aren't there also definite tests that other strains do not maintain that same consistency?

A. That is true, occasionally there is a strain found that is not constant. That is, its nitrogen fixing ability may drop. But strains of that nature is the exception rather than the rule.

Q. But there are such strains?

A. They do exist. When the strain is observed to vary in that manner, it is not used in making a commercial product.

Q. Now, I will ask you if you can tell us when this

business of artificial cultures had its origin in plant pathology, do you know?

277 A. It was about the turn of the century that artificial cultures were made and sold for the purpose intended.

Q. It was at the beginning of this century?

A. About at the beginning of the century.

Q. Well, will you go so far as to agree with me that in the beginning there was practically a unanimity of opinion among the scientists and those skilled in the art that there was only one strain of bacteria that was specific for all kinds of leguminous plants? Wasn't that the original thought of the scientists?

A. At one time, in the early history of the development of the culture of legume nodule bacteria, some investigators believed that there was one organism, but that has subsequently been disproven.

Q. Well, won't you agree that there is even now a school of thought among competent, reputable bacteriologists and scientists in this field that that original thought was correct? I am not asking you to state whether that is correct or not, but I am simply asking you to state if you don't know that there are these two schools of thought, one holding the single strain and the other holding the cross-inoculation strains.

278 A. To my knowledge there is no school of thought that holds that one species will cross-inoculate all the inoculation groups.

Q. Well, that is the majority of them. Is there a school of thought that holds that it is—

A. That is particularly true in the cultures isolated from some of the wild legume plants.

Q. You don't think it would be applicable to alfalfa and clover or alfalfa and soy beans or something like that?

A. Such crossing of the groups of inoculation is extremely rare in the case of clover, alfalfa and soy beans.

Q. And you deny that there is a school of thought maintained by any reputable scientists that there is the single strain that would be effective in those sort of groupings?

A. Such a strain may be found, but of the thousands of strains tested that is an extremely rare occurrence.

Q. I am not asking you as to the facts, I am simply asking you if you don't know that there is that school of thought among some reputable scientists.

A. That an organism may be isolated from clover
279 that will also form nodules on alfalfa and soy beans, is that the question?

Q. Yes. I am not asking you whether that is a fact or not, I am asking you whether that is a fact that there is a school of thought that holds that.

A. This school of thought may believe that such an organism may exist, but they also know that there are many of the organisms that belong to those groups that do not cross. The same school of thought, I am sure, will agree with me on that point.

Q. Well, then let's come back for a moment to your own artificial culture, and I am correct, am I not, in my interpretation of the statements in your patent that after you have gotten your separate cultures—

A. Excuse me, I believe I left—I couldn't find my data that I had up here and my patent is not there. I thought it was in my briefcase but I left it on the table. (Procuring data.)

Q. Now, coming back to Judge Briggle's thought, was my idea in connection with this question. After you have gotten your separate cultures of bacteria, then you have subjected them to a test as to their nitrogen fixing ability.

280 A. Not after; that is, we subject the strain that we start with to the test.

Q. All right, the strain.

A. But not in the commercial production of the product, there are no tests made for efficiency.

Q. It is a test of the strain itself?

A. The strain itself is tested.

Q. Separately?

A. Yes.

Q. And that is what you mean in claim No. 1, for instance, where you say, "An inoculant for leguminous plants comprising a plurality of selected cultures of different species", that word "selected" means that you have selected the individual strains that have a high nitrogen fixation value?

A. Going further, though, the cultures are also selected, "said cultures being substantially unaffected by each other in respect to their ability to fix nitrogen."

Q. I am coming to that later. I want now what you mean by the word "selected" there.

A. They were selected on that basis.

Q. On their basis first of nitrogen fixation value as separate cultures, that is your first selection?

281 A. Of course, there is no sense in trying to find—if the strain is non-inhibitive if it isn't even efficient—that is not what I mean here when I say "selected" in this claim 1.

Q. I am not speaking of inhibitive or non-inhibitive, I am taking the single strain.

A. Yes.

Q. And I am trying to find out what you mean by the word "selected" in the first part of this claim. Now, we will come to the inhibitive selection later on, I am taking now what you mean—you say "a plurality of selected cultures of different species of bacteria of the genus Rhizobium." That is one thought, and that selection—I am not barring you from your inhibition if you want to set that up later, but that thought and that selection is the selection of efficient strains for fixing nitrogen as separate strains, is it not?

A. That isn't a selection for efficiency in fixing nitrogen in the mixture.

Q. Let us turn, Mr. Bond,—if you want to be honest and fair with me in this matter, let us turn to page—

A. It is very clearly stated in the claim.

282 Q. —page 5 of your patent, on column 1, beginning at line 9:

> "Each of the strains are tested separately with its own host plant in order to select out those which are most effective in respect to the development of the host plant and the quantity of nitrogen fixed thereby."

A. I am sorry.

Q. Now, that is the selection that you referred to in claim 1 as being the selected cultures of different species of bacteria of the genus Rhizobium, is it not?

A. Wait a minute. I misunderstood you when you quoted the line and I did not find where you are stating. Was it line 9?

Q. Beginning with line 9 on column 1, page 5, where you are beginning to describe how you make your composite culture, and the first thing you do is to select the single cultures.

A. That is true, they are selected first, because there is no sense of even thinking of putting a culture in a

product that isn't good in the first place; so claim 1 would be first they selected a strain and tested it to determine whether there is any inhibition there.

283 Q. That is all right, you have selected your single strains.

A. Also selected the single strains to be put in the mixture, and that is what claim 1 refers to.

Q. You selected the single strains which you propose to put in your mixture?

A. Yes.

Q. Now, you don't know whether that is an alpha strain or a non-alpha strain at that time, do you?

A. No.

Q. And you don't know any way of determining whether it is an alpha strain or a non-alpha strain except by subjecting it to a routine test.

A. Yes.

Q. Now, by an alpha strain I mean a strain as defined in your specifications, as one which has no inhibitory affect or is not affected by association with some other strain.

A. Yes.

Q. That is what we mean in the terms of your patent when referring to an alpha strain.

A. Yes.

Q. And this test that you subject your selected

284 individual strains to, to determine whether they were alpha strains or not, was a routine, well known laboratory test.

A. Yes.

Q. The same as your efficiency test of a single strain, was it not?

A. Yes.

Q. You did not invent that test?

A. No, no.

Q. Now, you state in your patent that:

> "The cultures showing the best results in association with the host plant may then be selected and the various strains of the different species may be mixed together in order to determine if the nitrogen fixing ability of one species is adversely affected by the mere presence of another, as has been previously thought to be the case."

You then go on down and on line 38, in that same column 1, on page 5, you say:

"No method has been observed whereby the alpha strains of the organisms may be differentiated from the mutually inhibitive group of Rhizobia other than
285 by making actual nitrogen fixation tests by inoculating the various host plants with the proposed mixture of the Rhizobia."

That is a correct quotation from your patent, is it not, to the effect that there is no method that has been observed?

A. Yes.

Q. Therefore that means, does it not, that nothing that you have done to these bacteria brings about a state of inhibition or a state of non-inhibition.

A. No.

Q. That is simply, then, the work of nature, and you apply tests to observe whether or not that physical fact of nature is in existence in these Rhizobia or is not in existence?

A. Yes.

Q. That is correct. Now, this book that is entitled "Root Nodule Bacteria and Leguminous Plants", and is referred to as the University of Wisconsin studies in science, was published in 1932, was it not? Have you got a copy of that book with you?

A. I don't have it here.

286 (Book handed to the witness.)

Q. Did I say published in 1935?

A. 1932.

Q. 1932 is correct. Were you at the University of Wisconsin at that time?

A. I was attending school at the University of Wisconsin at that time.

Q. And I take it you were entirely familiar with this book?

A. I am not entirely familiar with each page in the book but I am familiar with the book, yes.

Q. Well, you knew of the book?

A. Oh, yes.

Q. And it was widely circulated among scientists and those skilled in this particula art, was it not?

A. Yes.

Q. The fact of the matter is, it is pretty generally regarded as the Bible in these root nodule bacteria and leguminous plant cultures in this country, is it not?

A. Yes.

Q. Now, did you consult this book at all when you went to the University of Wisconsin in 1937, to
287 ascertain the question of whether there was a different belief in inhibition or non-inhibition?

A. Yes, I consulted the book before I went to the University of Wisconsin.

Q. And it is your view that that book maintains that there is such a thing as inhibition, is it?

A. The book makes a statement that can be interpreted that way.

Q. And that is the statement that you quoted this morning on pages 244, 245 and 254?

A. Yes.

Q. Well, now I will ask you to turn to page 114 of that book, and the last sentence on the first full paragraph—not the full paragraph but the last sentence on the paragraph of page 114 reads:

> "A mixture of nodule bacteria from pea, clover, cowpea, and soy bean nodules are likewise not mutually antagonistic."

Do you agree with that or not?

A. I agree with that to which it pertains in this book. I have the original paper here by Alicante to which you are referring, and there is no data in this paper showing the exact details of these tests but Alicante concluded
288 that they could grow together just as well. He conducted no nitrogen fixation tests of any kind.

This antagonism does not refer to antagonism in respect to nitrogen fixation. I have the original book on the table if you would like to check the original article.

Q. Well, you are testifying, Mr. Bond, not me. I am asking the questions. You do not agree with that as being a statement—

Mr. Thiess: When you asked the question he wasn't presented the book. Would you like to see it?

Mr. Greer: I am not interested in it at all, I am merely asking whether he agrees with this statement that "a mixture of nodule bacteria from pea, clover, cowpea and soy bean nodules are likewise not mutually antagonistic."

A. With respect to growth.

Q. And I understand you to say that you do not agree with that.

A. I agree with it with respect to growth of the organisms, not with respect to nitrogen fixation. He conducted no tests on nitrogen fixation.

Q. Very well, if that is your interpretation of it.
289 Now, likewise on page 244 that you spoke of this morning, just above the heading "Composite Culture" there is a reference in there speaking particularly to the farmogerm culture. That was the farmogerm culture of the Earp-Thomas Company. That is referred to there, is it not, in that paragraph?

A. To the best of my knowledge, it is.

Q. And the sentence reads that according to Manns and Goheen, 16, Earp-Thomas, 21 and 22, and others, humus alone, where properly reinforced with nutrient salts, offers a very favorable medium for nodule bacteria. Did you consult that work of Manns and Goheen in your research to determine anything at all about the question of inhibition?

A. No. Manns and Goheen, the paper which I have checked contributes nothing in respect to nitrogen fixation by the plants.

Q. You are familiar with that publication that is referred to here, then, of Manns and Goheen, in 16.

A. Yes. Excuse me, I would like to get a summary of this paper.

Q. At any rate, as I understand it, your interpretation of that bulletin is that it teaches that there is no such thing as non-inhibition or inhibition.

290 A. This bulletin of Manns and Goheen—to my knowledge does not demonstrate either.

Q. It doesn't mention the question of inhibition or not?

A. No, in respect to nitrogen fixation, when we speak of inhibition, in regard to the patent we are not speaking of inhibition with respect to merely the growth of the bacteria.

Q. Do you think that if there is no affecting of the growth, that that would not be any indication of inhibition?

A. Of course, if the growth were affected the cultures would be antagonized or the growth would be reduced.

Q. And would the reverse be true, that if the growth was better with a mixture of the cultures that there would not be antagonism?

A. As far as growth is concerned; not as far as nitrogen fixation is concerned.

Q. Would it show anything with respect to nitrogen fixation?

A. It would not show a thing as far as nitrogen fixation is concerned.

Q. Very well. We will let it rest with that. Now, I want to turn to your patent again. At page 6, in
291 column 1, as I interpret this, you say, beginning with line 25, that your test consisted of—(reading):

"—a series of tests were made by planting red clover seeds in half gallon jars containing sterile sand supplemented with all essential minerals except nitrogen, and were inoculated as indicated below. After ten weeks of growth in the greenhouse under identical conditions, the sand was washed from the roots of the plants, the plants dried, weighed and ground and samples were analyzed by the Kjeldahl method for their nitrogen content.

"Each group or series of seeds was planted in a series of five jars and the standard deviation between the jars of each culture series was determined".

Then you say in the footnote down right after line 70 that the standard of deviation of the means of a series of five jars, and in the headings of your chart you say, first column: Grams dry weight per 10 plants, and in the third column: Milligrams nitrogen per 10 plants, and in the fourth column: Milligrams nitrogen fixed per 10 plants.

Does that mean that in each one of these five pots there were ten plants?

292 A. No; there were not ten plants in each of the five pots. To put it in terms of ten plants, it is a convenient measure to give me convenient figures for statistical analysis of the data.

It doesn't make any difference whether it is reported of ten plants, one plant, or one hundred plants. It does not change the significance of the results. But the amount of the dried weight for ten plants was obtained in this way: The number of plants grown was determined and the dry weights were determined, and the total dry weights of the five pots divided by the total number of plants in five pots, multiplied by ten, gives you the figure which gives you the grams dry weight per ten plants.

It is not an unusual procedure in outlining data of this nature to indicate it in that fashion.

Q. It is a positive statement that there were five pots in each series.

A. There were five pots in each series and I corrected that this morning by indicating that Series 2 and 4 were conducted with three replicates.

Q. Yes, but you have never made that correction with the patent Office, did you?

A. I didn't discover the difference until, in re-
293 checking my data in preparation for the trial. The significance of the means, when the standard deviation of the mean is taken, and this I know is just as significant whether you use three or five pots, as long as you adjust it with the standard deviation of the mean. I mean it is statistically acceptable.

Q. It doesn't make any difference whether you use three or five pots in the whole series; that is, three in each series or five in each series?

A. No; you can compare five in one series and three in the next series if you analyze it statistically.

The standard deviation of the mean increases as the number of pots decreases so that you have handicapped yourself in the smaller number of pots used.

Q. Then, as I understand it, what you actually did was a series which consisted of five pots?

A. Yes, sir.

Q. Series 2 of three pots?

A. Yes.

Q. Series 3 of 5 pots?

A. Yes.

Q. Series 4 of 5 pots?

A. No; four, Series 4 was three pots.

294 Q. Series 5 was 3 pots?

A. No; 4 was 3 pots and 5 was 5 pots.

Q. I didn't understand you.

A. Series 1 had five pots in it; Series 2 had three pots in it; Series 3 had five pots in it; Series 4 had three pots in it, and Series 5 had 5 pots.

Q. 4 had just three pots to it, did it?

A. 4 had three pots and 2 had thre pots.

Q. 2, 4 and 5 had three pots.

Mr. Thiess: No, 2 and 4.

The Witness: 2 and 4.

Q. (By Mr. Greer): 2 and 4, but 5 had 5 pots?

A. 5 had 5 pots.

Q. Now, I will ask you to tell me if there isn't another error in that chart, Mr. Bond, as I read the figures,—maybe my arithmetic is bad,—that 6.5 in the series which

is the amount of nitrogen that was in the seeds themselves in your control plant,—that is correct, is it not?

A. That is correct.

Q. Then the 122.0 in the next series, the 122.0 is the total nitrogen fixation including the 6.5 that was in the seed?

A. Yes.

295 Q. So to get the amount that was fixed by the bacteria that inoculates the plant, you subtract that 6.5 from the 122.0?

A. Yes.

Q. And that gives you 115.5 in the fourth column, is that correct?

A. That is correct.

Q. With that plus or minus of 10.0. Now, will you look down on Series 4 where you have the milligram nitrogen per ten plants of 80.8 and in the figures you submitted to the Patent Office as published in your patent is that the total nitrogen fixation from the bacteria is 72.3?

A. That is right.

Q. You do the same thing there to get that, don't you?

A. Yes.

Q. That is, you subtract 6.5 from 80.8?

A. Yes.

Q. Will you subtract that and tell me whether you get 72.3?

A. It should be 74.3.

Q. You never checked that or made any correction of that with the Patent Office?

A. I didn't notice that.

296 Mr. Thiess: I might state for the court's information that none of us have noticed that until just now but I would say it was an obvious error evident to anybody who would check the mathematics.

Mr. Greer: I say scientists are not supposed to make obvious errors or any other kinds of errors in submitting official tests to prove something.

Q. (By Mr. Greer) You produced as Plaintiff's Exhibits 14 and 15, photographs of tests which you have conducted showing the contrast of the uninoculated, the unmixed and the mixed strains of clover bacteria mixed with what other kind of bacteria was that,—Exhibit 14, for instance?

You mixed the clover in the third picture; you don't say what it was mixed with.

Q. (By Mr. Greer) Now 14 is a strain of clover;
297 that is the one on the right is a strain of clover mixed with what other kind of strain?

A. It is mixed with alfalfa strains and soybean strains.

Q. Alfalfa and soybean?

A. Alfalfa and soybean strains.

Q. And in Exhibit 15 you have a mixture of what?

A. Of soybean, alfalfa and clover.

Q. And the middle one is what, a single strain, unmixed?

A. That is 95-96.

Q. Clover?

A. No, it is soybean.

Q. It is single soybean in the middle?

A. Yes.

Q. And on the right it is a mixture of soybean and what?

A. And clover and alfalfa.

Q. Now, you produced those photographs of tests in which you claim inhibition is shown. As I understood your direct examination you ran a number of these tests and some of them showed what you called stimulation?

A. Yes.

Q. That means a beneficial nitrogen fixation in the mixed group, does it not, in the mixing of the strains?

A. Yes.

298 Q. Have you any photographs of those?

A. No, I haven't. I have the experimental data.

Q. How many tests, altogether, did you run?

A. Do you mean individual tests within a test or what do you mean by test,—the number of mixtures?

Q. Comparable to these exhibits. You produced photographs of two showing inhibition; I mean is it true that others showed stimulation, the opposite of inhibition?

A. Yes. These tests were conducted before the patent was applied for. At that time I did not know that I had stimulation. I had an indication in one experiment but the standard error overlapped, indicating it probably was not significant.

However, following this, in 1940 I ran a series, a large number of tests,—I believe there were about 400 pots in them,—and in those tests I found both stimulation and inhibition. Those are different tests than those in the photographs.

Q. But you only produced photographs showing inhibition?

A. Yes.

Q. You have no photographs showing stimulation?

A. I don't take photographs of all the tests.

Q. You don't take the ones unfavorable to your position?

A. I have photographs showing no inhibition.

299 Q. You have no photographs showing stimulation?

A. I have photographs showing no inhibition. They are in the patent proper.

Q. Showing no inhibition when they were in the mixed cultures?

A. When used in mixed culture.

Q. Photographs in the patent showing that?

A. It was discussed in the direct examination. Figure 3 representing a pot of clover plants in which the strains were single; Figure 4 representing a pot in which the strains were mixed.

Subsequent analysis of these plants showed no significance and difference between them indicating there was no inhibition in this case.

Q. Then it is a matter left to pure chance, as I understand it, whether there is inhibition or stimulation, or no effect whatsoever, as a result of this mixture, and the only way you can say whether it exists or not is to run standard routine tests?

A. It is necessary to run efficiency tests and to determine at least the dry weights and a more accurate estimation or determination is to determine the total nitrogen content.

Q. Now you knew when you went with the Kalo 300 Inoculant Company,—that was in 1937 I believe, was it not?

A. 1936.

Q. —that they were at that time putting out this garden-sized culture?

A. I don't recall if they were making it that year or not.

Q. How about 1937?

A. There was a period where the Kalo Inoculant Company did not produce a mixed garden culture. I don't remember back exactly what years they were, but I can check on it and give you that information.

Q. You know that they had sold a mixed garden culture before 1938?

A. Yes, mixed garden cultures, yes.

Q. The Kalo Inoculant Company itself had sold such a mixture, and that was composed of a plurality of different strains of the bacteria of the genus Rhizobium, was it not?

A. Yes.

Q. And there had been tests run on the strains, of the individual strains, that were in this mixture, to determine their efficiency in nitrogen fixation?

A. Yes. The cultures at one time were tested.

301 Q. The cultures at one time had been tested according to this standard efficiency test business that you have shown?

A. Yes.

Q. Now, they did not, as I understand you, run a test on the mixed culture itself?

A. Are you referring to since I have been there?

Q. Your knowledge of whether they had done it before you went there?

A. No. The Kalo Inoculant Company conducted no tests before I came there, of any kind.

Q. Or their predecessor, the Kalo Company?

A. Or the Kalo Company, not to my knowledge. I do not know that they conducted any tests. They were dependent upon Earp-Thomas for their information.

Q. It may have been even without showing the test that in this garden mixture there was what you now call an alpha strain of the bacteria?

A. There might have been. There was no way to know, without running tests.

Q. Did you ever see any plants grown by the use of this garden mixture?

A. Yes, the mixture will produce a benefit to the crop. Even a culture containing inhibitive strains will pro-

302 duce a benefit, will produce an increase over the uninoculated control, but will not produce the maximum, the optimum increase which could be obtained by a highly efficient culture.

Q. But you could tell from visual examination as to a beneficial result, if it was there?

A. If there was a distinct amount of it, as distinguished from the different controls, you could tell from visual observation.

Q. Now, you knew that these competitors of the Kalo

Inoculant Company likewise were selling similar garden mixed cultures?

A. Yes.

Q. And that was before 1937 or 1938?

A. Yes.

Mr. Greer: No further cross.

The Court: Any redirect examination?

Mr. Thiess: Just a few questions on redirect.

Redirect Examination by Mr. Thiess.

Q. Mr. Bond, you were questioned on cross-examination about a trip that you made to the Agricultural Laboratories, Inc.

303 How did you happen to make that trip? Were you solicited to come there by somebody in that company?

A. I was solicited to come there by the manager of the Agricultural Laboratories.

Q. And when did you make your trip?

A. To the best of my recollection it was in 1941.

Q. After your patent had been filed and issued?

A. Yes.

Q. And what was the purpose of going there? Why did they ask you to come?

A. To consult with them relative to a position in their laboratories.

Q. In other words, they wanted to employ you.

A. Yes.

Q. And that is the reason you went there?

A. Yes.

Q. And they paid your expenses?

A. Yes.

Q. Now, you have been questioned about these photographs, Exhibits 14 and 15, particularly, that you happened to have those; I would like to ask you if you can tell me what the Society of American Bacteriologists is and particularly the branch of that Society known as

304 the Agricultural and Industrial Bacterial Section?

A. The Society of American Bacteriologists is a scientific organization comprised of professional bacteriologists in all the different fields of bacteriology.

This Section, which you refer to, deals with bacteriology in its application to those particular fields.

Q. And is that a well-recognized society in this particular art?

A. Yes, it is.

Q. (By Mr. Thiess) And, as I understand it, on Au-

gust 30, 1938 you read a paper before the Society, did you, on this matter of your discovery and what is contained in your patent?

A. Yes.

Q. And were these two photographs, Exhibits 14 and 15, prepared to make slides for this paper?

A. Yes.

305 Q. (By Mr. Thiess) You were referred to a quotation from the book: Root Nodule Bacteria in Leguminous Plants, and I would like to have you read into the record the sentence prior to the part that was quoted.

A. Alicante, 1926—

Mr. Greer: Where are you reading from?

Mr. Thiess: The sentence just prior to the one that you quoted to him.

Mr. Greer: On what page.

The Witness: Page 114.

A. (continued) Alicante, 1926, found a number of organisms non-injurious to the Rhizobia, i.e., B. radiobacter Azotobacter chroococcum, B. prodigiosus, B. capsulatus, B. subtilis, B. mesentericus, a pink yeast and
306 some molds. A mixture of nodule bacteria from pea, clover, cowpea and soybean nodules are likewise not mutually antagonistic."

Q. Now, as I understand it, that is not the statement of the author's but a quotation from the paper by Alicante, is that correct?

A. It is not a quotation from the paper of Alicante; it is a summary made by the authors of the paper, a part of the paper.

The Court: Will you have the witness tell me where he claims that what he has done in disclosing the patent here, where it differs in principle from the garden product that was referred to in the cross-examination, where there was a variety of cultures used for the garden seeds?

Q. (By Mr. Thiess) Will you answer that question?

A. Garden cultures are a mixture of different groups and the components, the different component species, have been presumably tested for efficiency.

What effect they have on each other in the mixture was not known, and as far as our own product is concerned, we do not know now, but there was nothing to indicate whether the organisms were noninhibitive or not.

307 It is a simple mixture. The patent refers to a

mixture of prepared and selected strains so that you know it is a good culture. The garden cultures were thrown together and there was no way of telling whether it was going to produce a maximum or optimum increase in yield.

The Court: You only judged by the fact that there was some beneficial results?

The Witness: There was some beneficial results and that was satisfactory for the purpose this culture was intended.

The Court: So far as your combination is concerned, you have the same thing except that you have selected them scientifically, we will say.

The Witness: So that a maximum result, an optimum result is obtained. There is a very important difference. There are two problems involved, as far as the garden culture and the field legume seed cultures are concerned.

The garden culture is used on a small amount of seed in gardens where normally the seeds are planted in a fairly rich soil anyway; any increase in yield will be beneficial to those garden plants.

But in the field you have a different problem. The unique advantage of selecting a highly efficient culture
308 of optimum strains, so that the best possible increase can be obtained, is a very important one.

A strain that is 20% less in a field culture would produce a serious economic loss, whereas a strain that might be 20% less in a garden culture would produce less garden yield but doesn't have the same significance that the other does.

The Court: Was there any commercial product put out for use for clover and alfalfa and soybeans of a combination prior to your patent?

The Witness: There were some cultures on the market. There were none on the market at the time the patent was applied for. The tests on the other products—

The Court: When you say there were none on the market at the time the patent was applied for,—were there any when it was issued?

The Witness: Our own product was on the market when it was issued. There were none others, so far as I know.

The Court: Your own product built according to the patent?

The Witness: Built according to the patent. Previous to the patent mixed cultures had been prepared. Some

were claimed to be good on all legumes and some
309 were claimed to be good on just a few.

The results obtained with these cultures were very uncertain. Sometimes they didn't even form nodules on the plants for which they were recommended. In other words, the need for a mixed culture was shown in the early history of these mixed cultures but none of them survived on the market, to my knowledge anyway, much after 1930 when there were more intensive culture tests made by the State and the United States Government institutions.

Mr. Thiess: I just would like to ask one other question that might clarify that.

The Court: Yes.

Q. (By Mr. Thiess) In a garden culture would you get a result that would give you ultimate results on each of the seeds contained in the garden cultures equal to that if these seeds were inoculated by the single culture specific to each of the seeds in the garden culture?

A. No one knew. I mean, to the best of my knowledge no one had ever tested the individual strains in the garden cultures and compared them with the final mixture.

Mr. Thiess: Does that help?

The Court: Yes; I appreciate that; it was too small a business to warrant it.

310 The Witness: Yes; we have devoted what time we have for research to developing our field culture. We are doing a little work at the present time on the garden cultures and as soon as we can, that culture is going to be thoroughly checked to make sure that every strain which is there will produce optimum results.

We know that when they went in they were efficient strains but after they have been in the mixture we are not sure exactly how efficient they are.

The Court: I think that is clear.

Mr. Thiess: And your Honor understands the economics, does he, between this inoculation of seeds for field culture as compared with garden cultures?

The Court: Oh, yes.

Mr. Thiess: That is all.

Mr. Greer: Nothing further.

(Witness excused.)

The Court: Call your next witness.

Mr. Rathburn: Mr. Lusk.

MYRON E. LUSK called as a witness on behalf of the plaintiff, being first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Rathburn.

311 Q. Will you please state your full name and your residence?

A. Myron E. Lusk; 2116 Aldo Boulevard, Quincy, Illinois.

Q. What is your present occupation?

A. President and general manager of the Kalo Inoculant Company.

Q. How long have you been in the inoculant business?

A. Oh, about 13 years.

Q. By what company were you first employed?

A. The Kalo Company.

Q. In what capacity?

A. In charge of sales.

Q. Would you explain just generally how the Kalo Company carried on its business at the time you were first employed by them with respect to inoculants?

A. The Kalo Company, when I first started to sell inoculants for them, were sales agents for Humogerm, manufactured by Earp-Thomas Laboratories.

Q. Do I understand that the Earp-Thomas Company manufactured the culture?

A. They manufactured the culture under their own name and the Kalo Company acted as sales agents selling it and billing it and shipping it.

312 Q. The Kalo Company did what?

A. The Kalo Company sold it, and shipped it, and billed it, and paid Earp-Thomas Laboratories so much per unit for it.

Q. What was your experience with this culture so far as its success was concerned?

A. Most unfortunate.

Q. Would you elaborate on that a little bit?

A. Well, to begin with, Earp-Thomas Laboratories couldn't make enough deliveries to take care of the business which the Kalo Company secured. They lacked sufficient finance to buy cans and humus, etc., and the Kalo Company had to advance them money and ship them carloads of humus from Illinois. Then the quality was very bad.

The Kalo Company had no bacteriologists. They had nobody who knew anything about it. They were dependent upon Earp-Thomas, so when some poor tests started to come through, the Earp-Thomas Laboratories was approached about it and had an excuse that it was caused by this or that,—it would be corrected, and we wouldn't have any more trouble, but the next year would be worse.

Q. What was finally done about this?

A. Finally, in 1935, the state of Wisconsin notified
313 the Kalo Company that their license for the sale of the culture in that state would not be renewed the next year and I met Earp-Thomas in Chicago and went to Madison, to find out what could be done about it.

Finally, the arrangement was made that Earp-Thomas would not supervise any more cultures for the Kalo Company. If the contract were to be continued that a bacteriologist employed by the Kalo Company would be put in charge of production.

Q. And did you employ such a bacteriologist?

A. We employed two—

Q. What were their names?

A. —at the recommendation of the University of Wisconsin.

Q. What were their names?

A. One of them was there for just a short time to make an initial inspection and get things ironed out. That was Mr. Mickelson and another one was Leo Dick.

Q. And do I understand that Mr. Mickelson was at the Earp-Thomas Laboratories in your behalf for just a short time?

A. Yes; my memory is about two months.

Q. And from then on, do I understand that Mr. Dick was there?

314 A. Mr. Dick continued there as long as there was any contact with Earp-Thomas Laboratories, which was about, I should say, 15 or 16 months, until Mr. Bond was employed and we built the laboratory here for Kalo Inoculant Company.

Q. Are you still in the employ of the Kalo Company?

A. No; not since 1939.

Q. When was the Kalo Inoculant Company formed, and for what purpose?

A. In 1934, to finance the Kalo Company's operations on inoculation.

Q. And what was the working arrangement that they had with the Kalo Company at that time?

A. The Kalo Company sold and produced the inoculation and the Kalo Inoculant Company financed it and the Kalo Company got a percentage.

They were put in that financial difficulty by the inferior culture which Earp-Thomas had delivered.

Q. You referred a moment ago to hiring Mr. Bond. When did that occur?

A. He started with us, I think, in September, 1936.

Q. And what was your purpose in hiring Mr. Bond?

A. We had to figure whether to get into the inocu-
315 lation business or get out of it. We decided to go into it and build a laboratory and put a qualified man in charge.

Q. And what was the first thing you asked Mr. Bond to do after he was hired?

A. Well, when Mr. Bond was employed, the arrangement was that he was not to be interfered with in any way in the production of a good culture.

He was to be permitted to build his own laboratory, equip it as he thought best and to continue the research work he had been doing at the University of Wisconsin.

There wasn't any direction given to Mr. Bond as far as that culture was concerned. Along towards spring,—I would say May or June, I did ask him to undertake to find out why these mixed cultures were not successful and to see if one could not be made.

Q. Why did you want to make a mixed culture?

A. Primarily because the profit in the business lay in it. The operation was pretty small at that time. Returns were pretty heavy and the amount of returns até up the profit.

The unsold culture that would come back in the industry would frequently run to 30% and at the time of the Government hearings several years ago to con-
316 serve material they made some arrangements on the handling of those returns, and it was stated that the industry average was 20% returns.

Q. You felt you could cut down these returns?

A. There was no question about it because the returns originated from dealers' and jobbers' attempts to supply the farmers, which wasn't working out too good.

These cans come out a dozen to a case and in the spring a dealer normally will get what he thinks is a conservative part of his requirements. He cannot buy it all because he doesn't know how much seed of a certain kind will be

planted, but he does buy some stock. Clover is started to be planted, and it is pretty hectic about these seed dealers in clover seeding time.

They are pretty busy passing out clover seed and inoculation. The first thing they know they don't have much clover inoculation left. Then they are going to have to decide whether they are going to want any more in. If they do they will be stuck, if it isn't sold. It will be on their hands if they don't sell it, and although they get 50% of their cost back, they do have that loss and have the trouble sending it in and so they don't buy.

We wanted to make culture more available to farm-
317 ers, particularly in the small towns where it would help the small seed dealers, and where it might be, at the end of the season, where there would be no single culture available, for them to have the mixed culture.

He can sell it early in the spring for clover, later on for alfalfa, then in the course of the summer for soybeans, and again in the fall he can sell it again for alfalfa.

Q. Do you recall what Mr. Bond's reaction was to your request?

A. He rather laughed at me. He thought it would be impossible and didn't hesitate to say so, but I asked him not to make up his mind so fast but to investigate and see if there wasn't some error that could be found in some of this work, or some way he could find to make it, and he was going to the University of Wisconsin that summer to do some work on his Doctor's degree and said he would have an opportunity to re-investigate and read the literature and possibly could develop some idea about it.

When he returned in the fall he still wasn't optimistic. He was very far from it, and as I remember it, he told me then that there really wasn't much use fooling with it but
he did have an idea that it just might work, that he
318 might have located where the trouble was, and the way to correct it, and that he would like to set up some experiments in the spring. It was too late then to set them up in the fall; it would get too cold before he could do it, but he would have to have certain equipment, and would it be all right for him to buy it? And that was approved and these experiments were started.

319 Q. When was this Uni-Culture, which I understand is the product manufactured under the Bond patent first announced to the trade?

A. The first announcement was at the American Seed Trade meetings held at Detroit or Cleveland the latter part of June 1938. Deliveries, however, were not made until after the first of January 1939.

Q. To the best of your knowledge, was there any mixed culture for field seeds being offered for sale at the time that Uni-Culture was announced to the trade?

A. No.

Q. How was Uni-Culture received by the trade?

A. Very well. The business jumped on clover and alfalfa fifty-seven per cent the first year as a direct result of Uni-Culture. However, the biggest complication was the reaction of competitors.

Q. What was that reaction?

A. Very soon after Uni-Culture was announced we began to get the word the bacteria would fight, it wouldn't work, and we were foolish to put it out and no one should handle it. It culminated when the largest manufacturer got out a bulletin against Uni-Culture signed by his bac-
320 teriologist and we really felt that because they were prominent in the trade.

Q. Did you ever see one of these announcements by this competitor's bacteriologist?

A. Yes.

Q. I hand you a document and ask you if you can identify that. (Handing document to witness.)

A. That is the document to which I was referring. I can also identify the other.

Q. Did you ever see the original letter from which this was copied?

A. I did.

Q. How did it come into your possession?

A. By mail from one of our jobbers.

Q. Do you remember the name of that jobber?

A. I do.

Q. Do you know where the original letter is now?

A. The original letter was returned to them for their files.

Q. Do you know whether Mr. Sexauer, to whom this original letter was addressed, is still alive?

A. Mr. Sexauer is. Mr. Clark is not. He was the manager of the Sexauer Company.

Mr. Rathburn: If the Court please, I would like to read

into the record this letter which the witness has just
321 identified.

Mr. Greer: I would like to see the letter first.

(Document handed to Mr. Greer.)

The Court: For what length of time does it maintain its efficiency after it is put in cans?

The Witness: We date it for nine months. One year on single culture. We have experiments covering the period of twenty-six and twenty-eight months but, under the conditions of storage, we don't believe it should be dated that far ahead.

322 Mr. Rathburn: The letter reads as follows:

"George P. Sexauer & Son,
Des Moines, Iowa."

It is dated July 21, 1938.

"We have your advance NITRAGIN contract memorandum dated July 18, 1938, sent in by our Mr. C. A. Thomas. We are sending you at this time 200 red circulars like copy enclosed.

See copy of a report on the new big discovery Uni-Culture given me by our Dr. L. W. Erdman. Investigation has disclosed that they are simply mixing these cultures. It is not new at all. Records show that this was tried out many years ago and never has proven successful. We have been sending out a combination culture in the Garden Size for years for peas, culture
323 'C', beans, culture 'D', and lima beans, culture 'E' and for Lupines. We can do this successfully because the amount of seed is exceptionally small. These different groups of legume bacteria when mixed do not multiply at the same rate while in the container and this means that in due time one group has dominated the other. This means that these cultures cannot be depended upon after being in containers for some time. We thank you very kindly for the splendid cooperation you are giving us and we hope sincerely you will have a very successful year.

Very truly yours,

The Nitragin Company, Inc.

(Signed) L. D. Matchette"

Doctor Erdman's report reads as follows:

"Milwaukee, Wisconsin.
June 10, 1938.

To: Mr. L. D. Matchette
324 Re: Uni-Culture prepared by Kalo Inoculant Company.

Dear Mr. Matchette:

Careful study has been made of the claims, advertising and merchandising appeal of the announcement of Uni-Culture, which undoubtedly will provoke some thought among distributors of inoculants.

1. The name Uni-Culture is grossly misleading. It implies one culture for all legumes, whereas the announcement states only three cross-inoculation groups are involved, 'One can inoculates clovers, alfalfa, soy beans'.

2. The idea is far from being new, and if a patent should be granted it would mean nothing. Quoting from University of Wisconsin Studies in Science No. 5, pages 244-5, by Fred, Baldwin, and McCoy."

325 "*Composite culture.* The desire to have one culture for several crops has led to the preparation of the so-called 'dual purpose' or 'universal culture,' Bredemann, 1912, and Vogel, 1917. In some such preparations, rhizobia of only two or three cross-inoculation groups are included, while in others the makers have gone to the extreme of mixing representatives of all of the more common cross-inoculation groups. Although this method may bring about fair nodule formation, the results are variable. The writers feel that composite cultures offer few advantages and certainly many disadvantages. Perhaps the only justification for this mixing of strains is in the case of the small-size garden culture. Because of the limited amount of seed to be sown, it may be desirable to have one culture containing the organisms for such crops as beans and peas and thus to reduce the cost of inoculation."

326 "3. The distributor letter states 'uni-Culture is the result of years of research and is announced only after having thoroughly proven its efficiency in severe laboratory, greenhouse and field tests. Uni-Culture results are equal in every respect to those secured by

the best single cultures, even after months of storage.' Such statements without authoritative proof mean absolutely nothing.

4. 'Uni-Culture—Greatly reduces returns—Reduces stocks of culture and sizes carried 2/3'. This is purely a sales appeal. It will interest a few dealers, like the 'dry-applied' culture, but results to be had by the farmer should be the ultimate consideration.

The Nitragin Company's policy has been to prepare a culture that will produce excellent results on legumes grown under a wide range of soil and climatic conditions. To accomplish this it is necessary to give prime consideration to such factors as large numbers, selection of highly efficient strains, etc.

We could grow a pure culture liquid suspension of a
327 selected number of strains of alfalfa group bacteria in one tank. In another tank we could grow the red clover group of bacteria, and in a third tank our selected strains of soybean bacteria. We could mix these suspension separately with the humus and then mix equal portions of the alfalfa, clover and soybean NITRAGIN. This would be the equivalent of UNI-CULTURE.

All other conditions being equal, and in order to give the same number of legume bacteria as we pack in our one bushel size, we would have to use a can three times as large as the one bushel size. If we would use the regular size one bushel can, we would be cutting the quantity of NITRAGIN to one-third for each culture group. Fine for the manufacturer but not so good for the farmer.

Another factor, which might seriously interfere with the efficiency of such a culture is the rate of growth of the different legume bacteria. We believe that most manufacturers of humus legume inoculants depend upon the increased growth of the legume bacteria after
328 they are mixed with the humus. It would be almost suicidal to mix a slow growing organism like the soybean bacteria with fast growers like the alfalfa and red clover bacteria. Such a culture if prepared, say in January, would theoretically contain relatively few soybean bacteria when it would be used on soybeans in May or June.

Many other points might be mentioned to elaborate on the disadvantages of such a culture as Uni-Culture. This should suffice until we are able to obtain authoritative opinions from outside sources.

Very truly yours,
The Nitragin Company, Inc.
Lewis W. Erdman, Director
Research and Production."

Mr. Rathburn: Q. Did you ever make any reply to that letter by Mr. Matchette to Mr. Sexauer, Mr. Lusk?

A. After we heard about that letter from several different persons, I wrote to Mr. Matchette to call his attention to the inaccuracies in the letters he had distributed and asked him for a correction. When no correction was forthcoming, I photostated the letter to Mr. Sexauer, photostated a copy of my letter to Mr. Matchette, and cir-
329 culated that to the seed trade.

Q. I hand you a document and ask you if you can identify this (handing document to witness)?

A. That is the letter written to Mr. Matchette to which I received no reply and which was circulated to the seed trade.

Mr. Rathburn: I offer in evidence as Plaintiff's Exhibit 17 the letter identified by the witness.

The Court: It may be received.

(Said document, being a letter from Mr. Lusk to Mr. Matchette, so offered, was received in evidence by the Court and marked Plaintiff's Exhibit 17.)

Mr. Rathburn: Q. Do I understand, Mr. Lusk, that when you first put UNI-CULTURE on the market it was a three-in-one culture for alfalfa, clover and soybeans?

A. That is right.

Q. Have you since put out any other form of Uni-Culture for field seeds?

A. Yes, we make it also for clover and alfalfa only.

Q. Why do you put out the two types of Uni-Culture?

330 A. After we put out the culture for three, including soybeans, the price of soybean cultures from some competitors was considerably lowered by which it could be purchased by the farmer cheaper than the soybeans could be purchased in a Uni-Culture combination.

We had a choice to make as to whether to reduce the price of Uni-Culture to the soybean basis or to bring out a single culture for soybeans at a competitive price. We didn't feel it was a good thing from the jobbers' and dealers' standpoint to put the full Uni-Culture combination on the soybean basis because the profit per can would be so low that they might not be interested in carrying it and handling it and selling it to the farmers.

Q. So then you brought out the so-called two-in-one culture which was applicable only to clover and alfalfa?

A. We make both Uni-Culture 3 which is clover, alfalfa and soybeans and Uni-Culture 2 which is for clover and alfalfa only.

The sales divide largely geographically. The three-in-one culture sells mostly to the north where the soybeans are not such an important crop. Through this area they buy Uni-Culture 2 plus the single culture for soy-
331 beans.

Q. Now, I believe you stated that at the time Uni-Culture was introduced on the market no national distributor or nobody had on the market a mixed culture for field seeds?

A. I know of none.

Q. How many national distributors of inoculants are there today?

A. Six that are recognized.

Q. How many of them now sell a mixed culture?

A. Three that I know of.

Q. I understand one of them is the Kalo Company and another is the Agricultural Laboratories.

A. Kalo Inoculant Company.

Q. Kalo Inoculant Company?

A. And the third is the Albert Dickinson Company.

Q. Could you give me the name of their product?

A. Simplex.

Q. Do you know approximately when Agricultural Laboratories put their combination Legume-Aid on the market?

A. 1941.

Q. Were you familiar with the fact that Agricultural Laboratories attempted at one time to hire Mr. Bond?

A. Yes.

332 Q. How did you happen to become familiar with that?

A. He told me that they were talking to him and that they had sent him money for expenses to come and see them and he wanted me to know about it and I advised him to go, to go and talk to them. If they had something better to offer than we had to offer, I wanted him to have it.

Q. Was that before or after the Agricultural Laboratories put their Legume-Aid on the market?

A. Before.

Q. I believe you testified a moment ago, Mr. Lusk, that your sales increased 57 per cent the first year after you put Uni-Culture on the market?

A. Correct. That is the sales of clover and alfalfa culture.

Q. Do you have any figures that would indicate how much they have increased since that time?

A. They have increased two and one-half times since the Uni-Culture was brought out.

Q. Do you have any figures on the approximate amount of clover and alfalfa Uni-Culture you sold last year?

A. Oh, I would say enough for about three-quarters of a million acres.

333 Q. That is enough Uni-Culture to plant approximately three-quarters of a million acres of alfalfa and clover combined?

A. Either.

Q. Does the Kalo Inoculant Company still sell single cultures for alfalfa?

A. No.

Q. Or single cultures for clover?

A. The first year after Uni-Culture came out we did have single cultures, but only 11 per cent of our total sales were on single cultures and the next year they were none. We didn't carry them beyond that.

Q. Will you please explain just generally what you consider to be the benefit to the farmer of a mixed culture?

A. The biggest benefit I can see for the farmer lies in its availability, particularly at the end of the planting season. You will recall a little while ago I spoke of the fact that the dealer had to decide whether to order inoculation after he ran out at the close of a planting period or risk getting stuck.

The result has been that as the season came to a close

and the business instead of being a rush was a trickle,
334 culture has not been available to the farmer, particularly in the smaller towns or the small seed dealer but with composite culture the dealer can handle it without the risk of getting stuck and it is easy for him to maintain a stock. He just buys so many cases.

You see, when Uni-Culture came out the ordinary dealer had to carry nine different sizes to accomplish what Uni-Culture accomplished in three. That is we had one-half bushel clover, one bushel clover and two and one-half bushels.

Q. What has been the policy of the Kalo Inoculant Company so far as marking the patent number of the Bond Patent on this Uni-Culture?

A. When the first Uni-Culture label was printed the patent had been applied for and "Patent Applied For" was put on it. Immediately after the patent was allowed the Patent Number was put on the label and has been there continuously since that time.

Mr. Rathburn: No further direct examination.

335 *Cross-Examination by Mr. Greer.*

Q. Mr. Lusk, with regard to the dealer handling your Uni-Culture which is a mixed culture, we will say, for alfalfa and clover, if you take this one package, he has got to put into one package the same number of bacteria that he would have to put in the single culture to cover the same territory when it is used by the farmer, would he not?

A. Yes.

Q. Therefore, one package of the single culture would be just half the size of this package which is for the combination, would it not?

A. Not necessarily. I am not a bacteriologist and don't propose to endeavor to answer those kind of questions because I can't answer, but, as I understand it, the size of a package has been the manufacturer's idea as to what amount he wanted to supply for easy mechanical distribution over the seed and had little relation with the capacity to hold bacteria, if that is what you mean.

Q. I mean you have got just enough bacteria in here,

according to your label, for one bushel of alfalfa or 336 clover?

A. Or two bushels of soybeans.

Q. Or two bushels of soybeans?

A. That is right.

Q. Now, say, that you have a single size, take your former single culture for one bushel of alfalfa, it would be approximately one-half the size of this one?

A. The same size exactly, because in our experience it required that much humus in order for the farmer to readily distribute it over his seed.

Q. At any rate, the Kalo Company originally had a contract with the Earp-Thomas Company for obtaining these cultures?

A. Yes.

Q. I hand you a photostatic copy—the original is somewhere around here—of a document entitled "Culture Chart" and a 1932 price list purporting to have come from the Kalo Company. Are you familiar with that chart as having been gotten out by your company, or one like it? I don't mean that identical one. (Handing document to witness.)

A. It has been so long ago, and so many pieces have gone out, but it looks like it might be.

Q. And that advertises a garden size culture on it, 337 does it not?

A. Garden.

Q. For peas, beans, sweet peas, lima beans, for twelve bushels of seed?

A. Yes.

Q. Now, that was a mixed culture, was it not?

A. Yes, sir.

Q. And that was sold under this trade name of moist powder Humogerm a humus based legume inoculant made with Farmogerm bacteria?

A. I presume so.

Q. How long did you continue selling—this is dated 1932—how long did you continue to sell that kind of product?

A. I think that the garden size was discontinued in 1934.

Q. When?

A. 1934.

Q. 1934?
A. Yes, 1934.
Q. And how long had you been selling it before 1934?
A. That price list would indicate two years, because they started selling it in 1932.
338 Q. Had you sold it before 1932 at all?
A. No.

Mr. Greer: I would like to have this circular marked—Culture Chart and 1932 price list marked for identification as Defendant's Exhibit 1.

(Said document being culture chart and 1932 price list was marked Defendant's Exhibit 1 for identification.)

Mr. Greer: Q. Did you ever see a label of this kind of the Earp-Thomas Laboratories, of Bloomfield, New Jersey?
A. No, I didn't. I understood they had stolen it.
Q. When did you understand they were selling a humogerm under a label like this?
A. After the Kalo Inoculant Company canceled their contract with them.
Q. That was in 1934?
A. No, sir, that was 1938.
Q. When?
A. 1938.
Q. 1938. Well, what did the Kalo Company sell between 1934, and 1938?
A. Well, the Kalo Company sold Earp-Thomas Cultures or cultures from the Earp-Thomas Laboratories
339 during that period, but it wasn't made by Earp-Thomas after 1935; it was made by Leo Dick at Earp-Thomas Laboratories.
Q. Well, was it still sold as Humogerm?
A. It was sold under Humogerm until July 1938.
Q. And it still was this garden size culture?
A. No, there was no garden size culture.
Q. Didn't have a garden size culture after 1934?
A. Not that I know of.
Q. Have you employed a garden size culture since then at all?
A. The Kalo Inoculant Company produced a garden size culture last year.

Q. Last year?

A. And is making it again now.

Q. Was that the same kind of garden size culture the Kalo Company had originally sold?

A. No, this was a good culture.

Q. What?

A. This was a good culture. I was under the opinion we did not get a good culture before.

340 Q. Now, as I understand you, in 1937 you suggested to Mr. Bond that you were desirous of having a composite culture containing two or more different strains of this bacteria?

A. I don't know whether we discussed two or more or all of them; I don't know.

Q. Well, a plurality of them, at any rate.

A. Yes.

Q. And that was your idea?

A. Yes, sir.

Q. And Mr. Bond told you then that he did not think it could be done very definitely, and he then went to the University of Wisconsin and came back and confirmed his statement that you could not have a composite culture?

A. But he had found an idea upon which he might base some hopeful experiments.

Q. And you told him to go ahead, that you wanted him to try to do it?

A. That is right.

Q. That your idea was to bring out this composite culture?

A. Providing one could be produced that was good.

341 Q. Yes, and that was the birth of this Uni-Culture?

A. Yes, sir.

Mr. Greer: I don't think there is any further cross examination.

Mr. Thiess: Well, then, plaintiff rests.

Whereupon plaintiff rested its case in chief.

343 Whereupon, at 4:05 o'clock P.M. Tuesday, June 26, 1945, an adjournment was taken until 9:00 o'clock A.M. Wednesday, June 27, 1945.

344 IN THE DISTRICT COURT OF THE UNITED STATES

Southern District of Illinois

Wednesday, June 27, 1945.

9:00 o'clock A.M.

Trial resumed pursuant to adjournment.

345 And thereupon the defendant, to maintain the issues on its part, introduced the following evidence, to wit:

IRVIN HAROLD CURIE, called as a witness on behalf of the defendant herein, being first duly sworn, testified as follows:

Direct Examination by Mr. Staley.

Q. Mr. Curie, would you please state your full name, your age and your present occupation?

A. Irvin Harold Curie. Age 44 years. I am Director of Research of Agricultural Laboratories.

Mr. Staley: Q. You are the same Mr. Curie that has previously testified in this present case with reference
346 to the products of the Agricultural Laboratories, Incorporated, of Columbus, Ohio, are you not?

A. I am.

Q. Mr. Curie, would you please give us your education and experience with reference to the field of plant pathology or bacteriology?

A. I received my Bachelor of Science Degree in 1923 from the College of Wooster, Wooster, Ohio.

I received my Master of Science Degree from Ohio State University in 1930.

In 1933-1934 I spent a year in residence at Ohio State University working in work towards a Doctor's Degree.

In regard to experience, beginning in 1923 I was employed at the Ohio Agricultural Experiment Station at Wooster, Ohio as a member of the Scientific staff and in the Division of Soil Biology as Assistant Soil Biologist.

In 1926 at the Station I began working on the legumes and legume bacteria and handling cultures for the same.

In 1927 and 1928 we began testing commercial cultures at the experiment station. These included greenhouse 347 tests. This work continued on into 1933.

In June 1933 I resigned from the Experiment Station Staff to take up a fellowship established by the McQueen Bacteria Company of Baltic, Ohio. They were manufacturers of inoculants. This fellowship was established to develop methods of producing a better inoculant, humus inoculant, and included the work previously mentioned at the Ohio State University in '33-'34.

In June 1934, on completing this fellowship, I was employed by the McQueen Bacteria Company as Bacteriologist and to supervise the production of their cultures. I was employed there until October 1937, at which time I went to Agricultural Laboratories, and have been continuously in their employ since that time.

Q. Now, Mr. Curie, in your experience in the field of legume bacteria and inoculants, have you made any nitrogen determinations of various legume plants?

A. I have made many such determinations.

Q. Have you made any other type of tests with reference to legume plants to determine the efficiency of one strain of legume bacteria relative to others?

A. Yes, I have.

348 Q. What type of test is that to which you refer?

A. Well, I have made greenhouse tests regarding the plant growth and followed by cropping the plants, determining their weights and their nitrogen content.

Q. So that you have had experience in the generally accepted methods of testing the legume bacteria to determine their efficiency from the symbiotic relationship of these bacteria with the legume plants?

A. I have.

Q. Now, Mr. Curie, with reference to your earlier testimony and the products of the Agricultural Laboratories, Incorporated, of Columbus, Ohio, you referred to the Legume-Aid inoculant that has been identified as Plaintiff's Exhibit No. 1. Did you have the manufacture of this inoculant under your control?

A. I did.

Q. Are the strains of the clover bacteria and of the alfalfa bacteria that are used in that Legume-Aid inoculant strains that are a part of your general stock culture of bacterial strains?

A. They are.

Q. Do any of these strains extend back in age prior to the date of the Bond Patent—

349 A. Many of them do.

Q. (Continuing:)—of August 24, 1938?

A. Yes, they do.

Q. During your period at Agricultural Laboratories have you ever made any nitrogen determination tests with reference to the efficiency of the use of a single strain of bacteria, with reference to the use of that same strain in combination with other bacterial strains or cross inoculation groups?

A. I have.

Q. What was the general type of that test you made, of the comparison?

A. That was a test conducted during the past year.

Q. Are those specific nitrogen determination tests to show the efficiency of the bacteria upon the legume plants?

A. In this particular test run this past year they were.

Q. Before this past year, that you refer to, did you ever previously make any nitrogen determination tests?

A. I have not made any nitrogen tests previously since I am in commercial inoculation work.

350 Mr. Staley: Q. And you have not specifically compared one strain of bacteria, such as the clover strain of bacteria, with another strain of bacteria in association with that strain prior to this present year?

A. No, I have not.

Q. That can be said of the cultures that went into the production of Legume-Aid which has been referred to as Plaintiff's Exhibit 1?

A. It is.

Q. You stated that you had been employed by the McQueen Bacteria Company of Baltic, Ohio in 1934. When you were at McQueen Bacteria Company were you in control of the manufacture of the inoculants?

A. I was.

Q. Would you give us the method of preparing the single strains of the bacteria while you were at the McQueen Bacteria Company?

A. Do you want that going clear back to the original culture? The methods are the methods commonly used.

We grew them—

351 Q. I would like for you to state the method in somewhat general terms without going into the specific details of isolation and carrying forward, but speaking of it in the general terms of the methods well known in the art.

A. Well, beginning with the test tube pure strain cultures we inoculated from this into pint bottles on nutrient agar and allowed growth to take place in that nutrient agar or on that nutrient agar for a period of five days or more as required.

After this growth had taken place we poured water into the bottle, filling it about half full, and then scrubbed the growth from the surface of the agar, mixing the growth into the water in a bottle and then pouring it out into suitable containers.

Q. Just what do you mean by scrubbing the growth from the agar?

A. The growth is on the surface of the agar. To merely put in water and pour it out again would remove some bacteria but, in order to remove all, or substantially all of them, they must be scraped or scrubbed from the surface.

Q. Did you remove any of the agar from the bottle?

352 A. There may at times have been particles broken off. We did not want to remove the agar.

Q. Please proceed.

A. This suspension prepared from a number of bottles, according to the quantity of humus to be inoculated, was then mixed thoroughly into a peat humus base.

Q. Just what do you mean by "suspension"?

A. "Suspension" is commonly—as we speak in this meaning is a mixture of bacterial cells in water or in a liquid medium. In this case suspension of the cells in water.

Q. In this case just exactly what did this suspension consist of?

A. It consisted of bacterial cells, a small amount of nutrient material, which was the surface of the agar, and would be carried into the agar, and water.

Q. Will you proceed, please, with the preparation of the product then?

A. After this product was mixed in the manner men-

tioned, it was packaged into suitable containers and placed on the market for sale.

Q. You mentioned that you used a peat. Is that comparable with the term that has been previously used,
353 "humus"?

A. Yes, peat humus, sometimes referred to as peat and sometimes as peat and at others as humus.

Q. Did this base material known as peat or humus have any bacterial nutrient in it that would support bacterial life?

A. It does have nutrient in it that will support bacterial life.

Q. Did you ever make any tests with reference to the strains of bacteria that you used at McQueen Laboratories at Baltic, Ohio?

A. Yes, they were regularly tested in the greenhouse for nodule formation and nitrogen fixation.

Q. If I understand you correctly then, you ran greenhouse tests?

A. Yes.

Q. Did you run nitrogen determination tests?

A. I did not.

Q. Did McQueen's, to your knowledge, ever produce a mixed culture that could be said to be a combination of more than one of the cross inoculation groups of legume bacteria?

A. They did. They were manufacturing such a
354 product when I went there and continued manufacturing during the entire period I was there.

Q. Do you know what that product was?

A. That was the garden inoculant which contained bacteria for plants of the pea, the bean, the lima bean and the lupine group.

Q. Now, you refer to those as "group", cross-inoculation groups of the legume bacteria? Would you indicate how many groups are in that garden mixture?

A. There were four groups in the garden mixture.

Q. I now hand you herewith a package that is entitled, "INOCULATION", "McQueen's Inoculator". "Good for Sweet Peas—Lupines, Garden Peas and Beans", and ask you if you identify that package?

A. Yes, I have seen many packages similar to that.

Q. Is that the type of product you were referring to as the garden mixture?

A. It is.

Q. Can you tell us the approximate time when the products of that nature were manufactured?

A. As I have stated, they were being manufactured when I went to McQueen's, and were manufactured during the period I was there. This particular package was
355 probably manufactured about the first of 1935; that is December of 1934 or January of 1935.

Q. How do you identify that period?

A. It is dated, the expiration date beyond which it should not be used, as August 1st, 1935. These packages were dated for a period of about nine months.

Q. Was that your general practice—

A. That was.

Q. (Continuing:)—to date all the packages with reference to an expiration date?

A. Yes.

Q. What was the reason for dating those packages?

A. Because the bacteria eventually decrease in numbers to such an extent it isn't safe to use the packages. Some of them might be perfectly good to use several years later, but because some of them deteriorate, some of them, or the storage conditions in which they are kept are not satisfactory, we don't consider it satisfactory to date them for more than one season.

Q. Was that dating of packages due to any deficiency so far as the bacteria itself is concerned?

A. I don't know that I entirely follow the question.

Q. The point is this, Mr. Curie, you said that you
356 dated these packages and that, due to various factors, that they might not be—some packages might be good for two or three years, whereas others might be good for a very short period. Would you just refer to some of those factors you were speaking of that might influence the fact of whether this product is good or isn't after a certain period of time?

A. One thing that is mentioned a lot, although it is not the primary factor, is the by-product the bacteria give off in their life in there which are unfavorable to their own continued growth and gradually cause conditions toxic to the organisms.

Q. Is that common to all bacteria?

A. Yes.

Q. Nothing peculiar to the bacteria you used in this package or product?

A. No. The principal cause of drying off is probably, drying or exposure to excessive heat which is beyond the control of the manufacturer.

Q. You don't have control of the storage conditions and you can't guarantee anything beyond that because of this bacterial life that exists, and you can't control that?

357 A. That is correct.

Mr. Staley: If Your Honor please, I would like to submit this package for identification as Defendant's Exhibit 2.

(Said package entitled "INOCULATION", "McQueen's Inoculator". "Good for Sweet Peas—Lupines, Garden Peas and Beans", was marked Defendant's Exhibit 2 for identification.)

Mr. Thiess: May I see it?

(Package handed to Mr. Thiess.)

Mr. Staley: Q. Mr. Curie, I now hand you herewith some photographs, and ask you if you can identify those photographs, identify the photographs with reference to the package that has been identified as Defendant's Exhibit 2 (handing photographs to witness)?

A. I believe that to be a reproduction of that package.

Q. Those photographs then are accurate reproductions of the package just referred to?

A. Yes.

The Court: Did you mark the photographs?

Mr. Staley: I would like to submit the photographs, two photographs consisting of both the front and back

358 side of the package that has been identified as Defendant's Exhibit 2 to be identified as Defendant's Exhibit 3.

(Said photographs portraying the front and back side of package marked Defendant's Exhibit 2 were marked Defendant's Exhibit 3.)

Mr. Staley: Q. Now, with reference to Defendant's

359 Exhibit 2, which is the package, and Defendant's Exhibit 3, which are the photographs, you previously mentioned that there are four cross-inoculation groups of bacteria culture in this package?

A. Yes.

Q. How did you produce or manufacture the product of the type that is contained in that package?

A. We, as described before, grew the bacteria in these pint bottles containing nutrient agar. To produce this culture we would take a certain number of bottles of peas, bottles of beans—

Q. Just a minute, Mr. Curie. Was the culturing of this bacteria, whether you were culturing that bacteria singly or whether you were culturing the bacteria altogether as a composite group?

A. We were culturing it singly. That is, pea bacteriae were in one bottle and bean bacteriae were in another bottle and to prepare the culture the bottles containing pea bacteriae and bottles containing bean bacteriae, bottles containing lima bean bacteriae and bottles containing lupine, were used in preparing this suspension by washing and scrubbing the growth from the bottles as previously described for a single culture.

360 Q. And you took the individual strains of bacteria from these individual bottles and put them into the suspension, as you call it?

A. Yes.

Q. Will you please proceed then with reference to the continued production of this product?

A. Having this suspension, it was mixed with peat humus, or peat humus, as described before. There is one statement there that might be added. When I went to McQueen's they were using a soil rather than peat humus and some packets contained a soil base rather than a humus base during the season of 1934 and 1935.

Q. Would you consider the two bases more or less interchangeable?

A. No, I would not. The peat humus is a superior base.

Q. In putting the suspension, as you have referred to it, into the humus base of the garden mixture, did you carry over into the base any substantial quantity of nutrient from the culture as it was developed in the test tubes?

A. There was this small amount of nutrient which is removed from the bottle in removing the growth.

361 Q. You have studied the Bond Patent in issue, Number 2,200,532, have you not?

A. I have.

Q. You know Mr. Bond's method of culturing the bacteria and the method of incorporating that bacteria into the humus base, do you not?

A. I do.

Q. What in your opinion as a scientist and as one who is skilled in the art of culturing these bacteriae and manufacturing legume inoculants have you to say with reference to the quantity of nutrient that you carried over into the base of the product that was manufactured at McQueen's and identified as the garden mixture with reference to the quantity of nutrient that would be carried over into a base as established by the method used by Mr. Bond in his patent?

A. I would judge that the quantity carried over by the methods we used would be less than the quantity carried over by the methods used by Mr. Bond.

Q. The actual nutrient that you carried over into the base, if I understand you correctly, is less than that which is carried over into the base by the method established by Mr. Bond?

362 Mr. Rathburn: Is he speaking of McQueen's practice now?

Mr. Staley: Yes.

The Witness: Yes.

Mr. Staley: Q. You also, I believe, know that Mr. Bond uses a humus base, do you not?

A. Yes, he does.

Q. What would you say with reference to the comparison of the base, peat base, as you have referred to it at McQueen Bacteria Company, with reference to the humus base Mr. Bond refers to in his patent?

A. They would be very similar.

Q. By that do you mean that one is interchanged with the other without any different effect?

A. Yes. In fact, at one time we did use peat from the same source they used.

Q. Do you know what that source is?

A. It was stated. Manito, Illinois.

363 Q. Also I believe you know, the method, with reference to Bond's patent, of the manner of individually culturing the bacteria in individual tubes or bottles, whichever it may be, before he mixes them together in the humus, do you not?

A. I do.

Q. Am I correct in stating that you also individually cultured your bacteria before incorporation in the humus of the garden mixture?

A. Yes.

Q. Knowing your own method at McQueen's, and knowing the method of the culturing of the bacteria as set forth in the Bond patent, would you say that the two methods are comparable?

A. They are comparable.

Q. So that the effect on the bacteria by your method would be of no difference from the effect of the bacteria as cultivated by the method set forth in the Bond patent, am I correct?

A. You are.

Q. Did you ever make any tests or perform any tests, I perhaps had better say, with reference to the garden mixture while you were manufacturing that product at
364 McQueen's?

A. Yes, the product was tested in the greenhouse.

Q. Did you apply that product to the various species of bacteria that was specific to the—I mean, apply the species of bacteria that are specific to the various legumes indicated on the packet, Defendant's Exhibit 2?

A. Yes, it was tested on peas, beans, lima beans, and lupines.

The Court: Is lupine a lima bean?

The Witness: It is another of these cross-inoculation groups.

Mr. Staley: The lupine is one of the flowers, your Honor.

The Witness: It is used as a flower largely.

The Court: Is that the name of a specific flower or when you say "lupine" does that cover a variety of different flowers?

The Witness: There are several species of lupines closely related.

Mr. Staley: But that is considered in one cross-inoculation group.

The Witness: It is all in one cross-inoculation
365 group.

The Court: The same as the sweet pea would be?

The Witness: Sweet peas are also included, just as

sweet peas and garden peas are two different kinds of peas.

Mr. Staley: Q. I believe you just stated that you did make some greenhouse tests on the various specific legumes that are specified on the packet?

A. We did.

Q. What would you say was the result of those tests with reference to inoculated or uninoculated plants?

A. The results indicated that the product stimulated the growth in nitrogen fixation of the plants inoculated with the product.

Q. Which method of determining or performing these tests did you use with reference to the product used here? That is, previously you stated you had run both greenhouse tests and nitrogen fixation tests in your experiments, and I was wondering which specific method you applied to this packet.

A. By greenhouse tests in nitrogen fixation, I mean the greenhouse tests indicated that the product stimulated the growth in nitrogen fixation of the plants.

366 Q. What are some of the factors involved in determining the efficiency of bacteria applied to a legume when you are using the greenhouse test?

A. The indication first of increased growth, the color of the leaf in particular. The size of the leaf is also larger with efficient inoculation, and general thriftiness of the plants.

Q. You previously stated that you had run nitrogen fixation tests at various times, am I correct?

A. Yes.

Q. In your experience as a scientist, and one in this field of legume bacteriology, would you say that there is any relationship between the so-called greenhouse test and the so-called nitrogen fixation test?

A. Yes, they are parallel tests.

Q. Just what do you mean by "parallel"?

A. Well, the nitrogen percentage follows the indications according to size and general vigor and color of the plants.

Q. Can one who is experienced in this field of legumes and legume bacteriology indicate or determine, with a fair degree of accuracy, as to the real efficiency of
367 the stimulation to a plant of the various bacteria that are used, so that in his own mind he can know how much nitrogen is fixed in a plant?

A. He can compare between two strains with a reasonable degree of accuracy by the growth of the plants.

Q. What do you mean by a reasonable degree of accuracy?

A. I would say within 10 to 15 per cent.

Q. While you were at McQueen's did you ever run or perform any tests on the individual strains of bacteria that were contained in what you might call your stock cultures?

A. Yes, they were also tested for efficiency in the greenhouse.

Q. Now, you mentioned efficiency and greenhouse in the same sentence. Was it a nitrogen fixation test or just a greenhouse test?

A. A greenhouse test.

Q. So that the test that you ran on the individual strains of these bacteria were of the same kind and type that you ran on the garden mixture, am I correct?

A. Yes, they were.

Q. Would you say that the greenhouse test is an
368 acceptable standard amongst the trade with reference to the stimulation effect that bacteria have upon the plant?

A. Yes, I believe it is.

Q. That, of course, is from your own experience of past years as a scientist in this field, am I correct?

A. Yes.

Q. Did you ever have tests, or perform tests, that were—we will say that extend concurrently, on the single strain of bacteria that were used in the garden mixture, and with the material, the product known as the garden mixture, so that you could see the greenhouse difference between the single strains of bacteria and the bacteria that might be used in the garden mixture?

A. Yes. Quite often we would make, for example, a lot of pea culture in the bottles. Part of these or a number of these bottles would be used to make the mixed culture. Others of the same lot of bottles would be used to make pea inoculation alone, a single culture, and they were therefore tested in the greenhouse at the same time.

Q. If I understand you correctly, then, you say
369 that you took the bacteria from one bottle and made up a single individual culture for peas?

A. Yes.

Q. And you took the bacteria from that same bottle—

A. Not from that same bottle, from another bottle made at the same time and inoculated with the same lot of pure culture.

Q. So the pure culture was identical in the two bottles?

A. Yes.

Q. And that identical culture you used in this garden mixture?

A. Yes.

Q. Now, is that true of each of the strains of the bacteria that you used in the garden mixture?

A. That was true of peas, beans, and lima beans.

Mr. Thiess: This all still refers to the McQueen's garden?

Mr. Staley: Yes, everything in the McQueen's garden up to this point.

The Witness: We did not sell lupines or did not have a demand for lupine culture in itself.

Mr. Staley: Q. Those peas, beans, and lima beans
370 that you speak of are, however, cross-inoculation groups, are they not?

A. They are three different cross-inoculation groups.

Q. And these three cross-inoculation groups were tested by the use of the mixed culture?

A. Yes.

Q. Known as the garden mixture. And you also had comparable tests running at the same time on the individual strains of the same bacteria, am I correct?

A. An individual—or tests running at the same time on an individual culture of peas.

Q. Did you ever notice any difference in the effect of the stimulation on the plants involved when you used the strain of bacteria separately or when you used it in combination with the garden mixture?

A. No, we could see no difference.

Q. Did you conduct experiments to determine
371 whether there was any conflict in the different individual strains and the combinations?

A. The tests were not set up with that idea in mind.

Q. And when you say—I think you said you observed no difference in the growth of the plants. That is a mere observation, I take it.

A. That is an observation on examination of these

plants. In other words, we have two tests running in the greenhouse at the same time. If there is a noticeable difference in those two tests, if we are on our toes, so to speak, in our examination, we would see differences which are apparent in the growth of those plants.

Mr. Staley: Q. With reference to the garden mixture again, what can you say as to the numbers of bacteria that went into the garden mixture?

A. We attempted to put them in in approximately or substantially the same numbers for each of the different groups.

Q. How did you do that?

A. From time to time we ran counts on the number
372 of bacteria in one of these bottles and for different groups, in this way: We established a general average of the number that could be expected in those bottles. The peas and beans run approximately the same number. The lima beans will run a somewhat larger number.

Q. What was the reason for that?

A. Well, just common experience in growing them, that usually in a lima bean culture you will have a larger number of bacterial cells than you do in peas or beans. It is nothing that we are attempting to do, it is simply the reaction and as they grow on the same agar base.

Q. Would you say that any two of the cross-inoculation groups in this mixed culture are, using the words of the Bond patent, in the same order of magnitude?

A. The numbers that we put in there were in the same order of magnitude.

Q. This garden mixture, as I understand it, in the packet form and identified as Defendant's Exhibit 2, was to be sold to gardeners, am I correct?

A. Principally used by home gardeners.

373 Q. Did you ever make any other mixed product besides garden culture?

A. We also put that same culture up in a larger package for use of the commercial truck garden grower who grew produce, vegetables, and in this case it would be peas and lima beans, for sale on the city markets.

Q. I now hand you a photostat, a positive photostat, of an advertisement of the McQueen's Bacteria Company, and ask you if you can identify that photostat?

The Witness: That is a reproduction of the price list issued by the McQueen's Company in the summer of 1937.

Mr. Staley: I would like to offer in evidence the two sheets of photostats and identify them as Defendant's Exhibit 4.

(Said photostatic copy of sheet of advertisement and the photostatic copy of Wholesale Price List, effective July 15, 1937—Season 1937-38, of McQueen's, 374 Inc., Baltic, Ohio, in re McQueen's Seed Inoculants, etc., were thereupon marked as Defendant's Exhibit 4 for identification.)

Mr. Thiess: If your Honor please, this is an advertisement of McQueen's, and with respect to anything—there are many statements of boasting and so on. I object to that. The only part of the advertisement that is pertinent would be those that are established by facts on the advertisement. In other words, any statements as to what this garden culture will do, as contained in conclusions in this advertisement, are merely conclusions in the boasting statements, and we object to those upon that ground.

The Court: The exhibit may be received with that limitation. That is the first exhibit that you have offered?

Mr. Staley: I am offering it only for identification at the present time. I would like to submit it for identification only and then we will offer all of the exhibits at one 375 time, if your Honor please.

Mr. Staley: Q. On Defendant's Exhibit 4 do you find any indication of the market size that you just referred to?

A. Yes, it is pictured on the first sheet at the middle of the right-hand side, market size inoculator for fifteen pounds of seed.

Q. Do you have any way of telling when that advertisement was put out?

A. The first sheet is dated July—or the second sheet here, which to us was the front of the advertisement, is dated July 15, 1937, and was issued at about or slightly before that time.

Q. You were at McQueen's at that time?

A. I was.

Q. These advertisements were available to you?

A. They were.

Q. You knew of the market size inoculator that was put out by McQueen's at that time?

A. I did.

The Court: It was given general circulation, was it, by McQueen's?

376 The Witness: Yes, it was distributed to the seed trade.

Q. You have heard Mr. Bond's direct testimony with regard to the use of bacterial inoculants in the field as compared to bacterial inoculants used in gardens, have you not?

A. I have.

Q. What have you to say with reference to the market size product in this same relationship?

A. This was used for commercial growing just as much as a farmer uses the other groups for raising crops for profit. The market gardener's cash value of produce per acre rates high in comparison with the normal field value of profit per acre, so I would say that that was an important use and an important product.

Q. Now, after you left the McQueen's Bacteria 377 Inoculant Company, of Baltic, Ohio, I understand you went with the Agricultural Laboratories, Inc., of Columbus, is that correct?

A. I did.

Q. You had control over the methods of manufacture, did you, or did you not?

A. I was associated in the production of the products at that time. I was not in complete control of it.

Q. You knew of the products that were being manufactured?

A. I did.

Q. Did the Agricultural Laboratories, Inc., manufacture any mixed culture at the time you went with them in the fall of 1937?

A. They were manufacturing a garden culture also.

Q. Would you please state as to the manner in which this garden culture was manufactured?

A. It was manufactured by preparing the cultures in the same way as elsewhere disclosed, except that the base used was a finely powdered charcoal rather than a peat humus. Otherwise the method of production was 378 similar.

Q. With reference to the mixed culture and the gar-

den grouping, what did the mixed culture that was manufactured by Agricultural Laboratories, Inc., include as to cross-inoculation groups?

A. It contained different pea, bean, lima bean, and lupine groups.

Q. You have mentioned that the Agricultural Laboratories product contained a charcoal base. What have you to say with reference to the nutrient value in a charcoal base with reference to that in a peat base?

A. Very much less nutrient value.

Q. In the manufacturing would you give in a little more detail the steps of manufacture of the mixed culture of the garden variety that was made at Agricultural Laboratories, Inc., at the time and just shortly after you went with them, with reference to the manner of incorporating the bacteria into the base?

A. At the time I went there we—I take it you are
379 referring to the preparation of culture suspension and the mixture with the base.

Q. That is correct.

A. We took bottles which were growing one cross-inoculation group, and that would be bottles for peas, bottles for beans, bottles for lima beans and bottles for lupines, and washed the growth from the surface of the agar in those bottles into a suitable container forming a suspension of bacterial cells.

Q. Was that incorporated in the charcoal?

A. And that suspension was then incorporated with the charcoal base.

Q. What have you to say with reference to the quantity of nutrient that was put into the charcoal base as a result of the method that was used at Agricultural Laboratories, with reference to the method of putting the bacteria into the base as set forth in the Bond patent?

A. The simple washing of the growth from the agar would carry over less nutrient than the method used and disclosed in the Bond patent.

Q. Would you say that the base of the garden mix-
380 ture produced at Agricultural Laboratories, using the charcoal base, was, using the words of the Bond patent, substantially free of bacterial nutrients?

A. As interpreted in the Bond patent, yes.

Mr. Thiess: Well, now, I object to that unless he says

what his interpretation is. We don't know what his interpretation is, and I move to strike it.

The Witness: My interpretation of that is that the suspension prepared according to the Bond patent, in which he carefully breaks up the agar and allows it to stand for a period of 24 to 36 hours, dissolves out soluble mineral materials and sugars contained in this agar, and that is carried into the peat humus base, which peat humus base carries sufficient material to establish the growth of the bacteria in that base; while with the other procedure, in which the water is poured into the bottles, scrubbed off and poured out again within a period of a few minutes, there will be a small amount of nutrient dissolved and the charcoal contains a small amount of potash but the other nutrients are substantially lacking.

The Court: Q. Which method is the more desirable?

381 A. We have at the Agricultural Laboratories changed over so that we are using a mixture of peat and charcoal as the base, because we have found to our satisfaction that that produces a better base than either one alone.

Q. Yes, but which is the better method of getting the growth from the agar, the method described by Mr. Bond that you just told about or the method you use? You said you get less nutrient in the method you use.

A. I prefer the method I use.

Q. Well, it would be advantageous to have all the nutrient possible in the base, wouldn't it?

A. No. Well, the nutrient isn't the main reason I do not like that method.

Q. Oh.

A. These bottles are allowed to stand for a period of 24 to 36 hours after that growth is washed loose. Now, there are foreign bacteria that do multiply rapidly in such a suspension, regardless of the presence of the legume bacteria, and there is a considerable number of foreign bacteria carried over into the peat after that procedure.

382 Q. Well, that is the reason you do not prefer that method?

A. That is.

Q. I thought you were emphasizing the fact that you got less nutrient in your method than in the other.

A. No, that is not my reason for preferring the other method.

Q. The other method, in that respect at least, would be desirable, then, wouldn't it, so far as the nutrient question is concerned?

A. Yes, it would not be undesirable.

Q. And the Agricultural Laboratories, Inc., now uses a combination base of charcoal and peat, do they?

A. Yes.

Q. In all of their products?

A. Yes.

Q. This package here, marked Defendant's Exhibit 1, has charcoal and peat?

A. Yes, there is a mixture of peat and charcoal.

Mr. Staley: Q. That change, however, was made when?

A. About 1939.

Q. After the date of the Bond patent, which is August 24, 1938?

A. I believe so.

383 Q. Did you ever test the garden mixture of Agricultural Laboratories, Inc.?

A. Yes; that mixture was tested in the greenhouse.

Q. By the same methods previously described?

A. Substantially the same methods.

Q. What were the conclusions, the results of your tests?

A. The conclusions were that the combination produced satisfactory stimulation of plant growth on the various plants that were supposed to be inoculated.

The Court: These were greenhouse tests, you say?

The Witness: Greenhouse tests.

Q. (By Mr. Staley) Mr. Curie, previously you stated—

Mr. Thiess: As I understand it, those are greenhouse tests you conducted of garden culture?

The Witness: Yes.

Mr. Thiess: At Agricultural Laboratories.

The Witness: Yes.

The Court: Pardon me. How long has the Agricultural Laboratories been putting out the combination or garden package?

The Witness: They were putting it out at the time I went with them, in October, 1937, and I don't know how long before that time.

384 Q. (By Mr. Staley) Do they still continue putting the garden culture out?

A. They do.

Q. Mr. Curie, you mentioned the fact earlier in your testimony that you had recently run or performed some nitrogen fixation tests. Would you please state what those tests were?

A. They were tests of individual strains of clover bacteria alone and in mixture with strains of alfalfa bacteria.

Q. I now hand you herewith a typewritten sheet of figures and ask you to identify that sheet (handing paper to the witness).

A. This sheet is a summary of the most recent test conducted.

Q. (By Mr. Staley) Can you tell me when those tests were made?

A. They were begun October 27, 1944.

Q. Can you tell me the circumstances under which those tests were run, and why they were run?

A. They were run to determine whether or not we
385 would find inhibition of efficiency of clover bacteria, as affected by the presence of alfalfa bacteria in the same mixture.

Q. Do you know if these tests were run after the filing of the Complaint in this case?

A. They were.

Mr. Staley: If your Honor please, I would like to present the original and have it marked Defendant's Exhibit No. 5.

(Said Summary headed: Efficiency of Clover Bacteria as Affected by Alfalfa Bacteria, and dated October 27, 1944, was marked Defendant's Exhibit No. 5, for identification.)

Q. (By Mr. Staley) Now with that sheet of figures in front of you, Mr. Curie, Defendant's Exhibit which has been identified as Defendant's Exhibit 5, will you please explain to the court the manner in which those tests were made, and what they mean?

A. These tests were set up for greenhouse in quart Mason jars, common quart Mason jars. These jars were filled to about an inch from the top with quartz sand and then watered with a nutrient solution containing the
386 necessary mineral elements for the growth of the bacteria, with the exception of nitrogen.

There were—

Mr. Staley: Pardon me just a moment, Mr. Curie.

Q. (By Mr. Staley) Were these tests run under sterile conditions?

A. After these jars were filled and watered a capsule was placed over them, and they were sterilized under 15 pounds of steam pressure for a period of two hours, so they were run under sterile conditions. After the jars had cooled they were arranged in sets or rows of five jars.

Q. What do you mean by sets of five jars?

A. On the greenhouse table five jars were placed in each row and in these jars as surface sterilized or disinfected clover seed was planted in each jar, approximately 10 to 12 seeds per jar.

After the seeds were in the jar they were inoculated by adding a suspension of the bacteria which we were proposing to test. That is, there was a row of five jars that was inoculated with clover bacteria, Strain 201.

Another row of jars immediately adjacent, was inoculated with an equal amount of this same clover strain mixed with alfalfa culture.

387 After they were inoculated the seeds were covered with a layer of dry sterile quartz sand and allowed to grow in the greenhouse. The same as described for Strain 201 was set up for each of the 12 strains listed here and then one suspension prepared mixing all of the clover strains together, a row inoculated with that, and another row, this clover suspension containing all strains mixed with alfalfa and a row inoculated with that mixture.

The Court: Did you have a row inoculated only with the alfalfa strains?

The Witness: We did not. This is a test of clover plants.

A. (continued) They were allowed to grow in the greenhouse and after about two weeks' time the plants were up and were showing growth, whether they were going to be normal plants.

At this time the small plants were thinned down to five plants in each jar to have comparable numbers in all jars.

They were then allowed to grow; they were watered as moisture was depleted in the jars and maintained for a period of from two to three months.

The Court: Did you apply this solution with the
388 bacteria more than one time?

The Witness: One time only at the planting of the seed.

A. (continued) At the end of this period, or after a period of some two months, photographs were taken of the jars and then the jars were harvested—

Q. (By Mr. Staley) Just a minute, Mr. Curie,—I don't like to break in at this point but you have the test of October, 1944 in your hands?

A. I have the test of October, 1944. These plants were harvested by cutting the top growth at the surface of the sand and drying it to constant weight in an oven and then determining the total nitrogen content of the five plants in each jar. The results are summarized on this sheet.

The Court: Just tell me: Is there any appreciable difference in the various series of pots?

The Witness: In plant growth, yes; there was marked difference in the growth of the different series of pots.

Mr. Staley: With reference to that point, your Honor, I would like to submit to the witness at this point some photographs he just mentioned with explanation.

The Court: All right.

389 Mr. Staley: And for identification I would like to put these photographs in and identify them as Defendant's Exhibit 6-A to L, inclusive.

(Said photographs, showing two rows of five jars in each row on each photograph, with plants therein, with heading above top row of Clover, heading in middle between rows as follows: Clover Bacteria 202, 2A1, 2A2, 2A3, 2A4, 2A5, 2A6, 2B1, 2B2, 2B3, and 2B4; and heading: 12 Strains Clover Bacteria; heading below the bottom rows of jars on each photograph as follows: Plus 12 Strains Alfalfa Bacteria, was marked Defendant's Exhibit 6-A to 6-L, inclusive, for identification.)

The Court: Defendant's Exhibit 6-A to 6-L, inclusive, is a series of photographs of the plants involved in the test just being testified about?

Mr. Staley: That is correct, your Honor.

Q. (By Mr. Staley) Now, Mr. Curie, I hand you the set of photographs which have been identified as De-
390 fendant's Exhibits 6-A to -L, inclusive, and ask you if

you can identify the photographs and explain these photographs with reference to the test that you have just mentioned.

A. The photographs were taken of these various series of various tests. In each picture are the five jars in each test. The first one shows—

Q. Mr. Curie, will you please refer to the strain numbers on the photographs as you refer to them, so that we can identify the exhibits as you go through, specifically?

A. The first picture refers to the clover bacteria strain 202 and the bottom row is this same clover strain plus a mixture containing 12 strains of alfalfa bacteria.

The Court: The first five jars are supposed to be the same?

The Witness: Yes; they were treated alike.

The Court: They were treated alike?

The Witness: Yes. And the bottom row was treated alike.

The Court: And inoculated?

The Witness: Yes; they were inoculated similarly.

Q. (By Mr. Staley) Was that with a single or with a mixed culture?

A. The upper row is the single strain, clover alone.
391 The bottom is the same clover strain mixed with alfalfa.

Now in this picture there is very little difference from the picture between the strain with or without the alfalfa present.

An analysis of weight per jar shows a difference of twenty milligrams.

393 A. (continued) The pictures as we may run through them: 2A1, the clover bacteria alone, to my eye, appear to be definitely less growth than the clover bacteria plus alfalfa; 2A2 shows poorer growth and very variable growth of the clover alone where this variation is not evident where the alfalfa is present.

2A3—

Q. (By Mr. Staley) You are speaking of strain numbers, aren't you?

A. Strain numbers on the picture. The next picture which is labelled as Clover Bacteria 2A3 shows variable growth in the clover alone but better than some of those earlier, and in this case the 12 strains of alfalfa bacteria also shows variation.

2A4 shows poor to fair growth of the clover bacteria alone and a definitely better growth when the alfalfa bacteria are present.

2A5 shows growth from poor to probably fair in the clover bacteria alone and the 12 strains plus the clover is variable but at a higher level.

In 2A6, four of the jars are very poor. The other one I would say showed obviously that there was a contamination by air borne means of another strain of clover bac-
394 teria.

To consider the results properly it is not fair to throw out because we think there is something wrong with it, when we don't know what the cause of the trouble is. So therefore, whether it agrees with the rest or not, I still leave that in there to take the picture.

The over-all comparison, the bacteria where the alfalfa is present, the growth is much better.

And the next picture, Clover Bacteria 2B1, shows decided variation where the clover is alone and rather good growth where the alfalfa bacteria are also present.

In the Clover Bacteria 2B2 we have two rather good jars and three poor ones. Again the variation is not nearly so great where the alfalfa bacteria are present with the clover.

2B3 shows four out of five have good growth of clover alone and similarly four out of five, good growth when the alfalfa is present.

Clover Bacteria 2B4 shows poor to fair growth when the clover is alone and rather good growth when alfalfa bacteria are also present.

The last picture shows a mixture of all 12 of these clover strains, in the upper section showing wide
395 variation in growth of individual jars and the lower picture where the alfalfa bacteria were mixed with this clover suspension shows very good growth throughout.

Now, from the series of pictures it appeared to the naked eye inspection that the alfalfa bacteria certainly had not reduced the growth of the clover and the effect of the clover bacteria but over-all, seemed to definitely improve the growth.

This test as has been noted, was begun October 27, 1944, and ran through November and December, which, while it was in the normal light of the year, is a rather low light

level, and no artificial light was used in growing these plants.

That may be a factor in the wide variations exhibited in the top section. I don't know what the variation is.

Q. Nevertheless, this laboratory procedure is standard practice, is it not?

A. It is.

Q. You previously mentioned that you harvested the crop after a certain period of time?

A. Yes.

Q. Did you subject the crop that you got off of these various jars to statistical analysis?

396 A. I did.

Q. Is that statistical analysis a part of the report that you have included in the Defendant's Exhibit 6?

A. It is; the result is the statistical analysis as indicated on the report.

Q. That is Defendant's Exhibit 5?

A. Yes.

Q. As a bacteriologist and scientist in the field of legume bacteriology, would you say that there has been any indication of inhibition?

A. No; there is no indication of inhibition. There is no strain among the 12 that shows a significant reduction in growth as judged by appearance, weight, or nitrogen fixation.

Q. To your knowledge, Mr. Curie, do you know of any reputable scientists in America, or in any other part of the world, as far as that goes; within your own knowledge, that ascribes to the theory or the fact that one strain of legume bacteria is inhibited when it is put into association with another strain of bacteria of the legume variety?

A. With the exception of the patent disclosure here I know of no reputable scientists in this country who

397 subscribe to a theory of inhibition.

Q. Do you confine your answer to this country?

A. Not necessarily.

Q. Mr. Curie, is the test data that you have just been referring to and which data has been compiled in Defendant's Exhibits 5 and 6, the only nitrogen fixation test that you have run?

A. It is not. I ran a test beginning in January of 1944, previous to this test.

Q. I now hand you herewith a report that for purposes of identification I would like to identify as Defendant's Exhibit 7.

(Said document entitled: The Effect of Alfalfa Nodule Bacteria Rhizobium Meliloti on the Activity of Clover Nodule Bacteria Rhizobium Trifolii, by I. H. Curie, was marked Defendant's Exhibit 7, for identification.)

I will ask you if you can identify that report and tell us what is in it.

A. This is a report of tests run to determine the effect of alfalfa nodule bacteria on the activity of clover
398 nodule bacteria. These tests were set up on January 7, 1944.

Q. Did you run these tests yourself?

A. I did. These tests were set up as were the later ones, by planting red clover seeds in quart Mason jars containing sterile quartz sand supplemented with all essential mineral nutrients except nitrogen.

They were inoculated as indicated below, which is substantially as is described in the other experiment.

Q. Was the inoculation carried forth in the same manner as in the other experiment?

A. It was. The preparation was substantially as in the other test.

Q. What did the results of this test show?

A. The results in this test show, beginning with Clover 201 alone, which culture was isolated, that is, put into pure culture, in agar culture, from a nodule, in 1922 or earlier.

Q. Mr. Curie, before you go any further will you identify these strains of alfalfa and clover bacteria in connection with the subsequent report you made?

A. They are the same 12 strains used in the subsequent report.

Q. You may now proceed.

399 A. This 201 clover alone gave a plant weight per jar of 242 milligrams. When alfalfa was added the weight was 420 milligrams of nitrogen.

The effect of the alfalfa was a plus 158 milligrams. That is a significant increase indicated by the presence of the clover strain.

The Court: Your experiment on the 201 clover on the other experiment is just the opposite, isn't it,—it shows a minus?

The Witness: Yes. In other words, there were variations in the strain itself between these two times.

The Court: Is that the way you account for the variation in the single clover strain itself?

The Witness: Yes.

The Court: What do you mean by the isolated in the year 1922? I didn't get your information on that.

The Witness: This culture was obtained— They were either obtained from the University of Wisconsin or from the United States Department of Agriculture. Our records show that this culture has been in their collection since 1922. In that year it was either isolated from a plant, from a nodule on a plant, or selected from some culture.

The Court: Did you use the same culture in the sub-
400 sequent experiment shown on Exhibit 5?

The Witness: Yes, it is a transfer of the same culture.

A. (continued) Now Strain 202,— In this case the Strain 202 was selected in 1935. In this case there was a loss of 116 milligrams as the effect of alfalfa. This loss is statistically significant.

As we go through the group of them we find 2A1 had an increase but the increase was not sufficient to be termed significant. It may have been due to chance.

2A2 showed an increase which was significant. 2A3, isolated in 1922—

The Court: 2A1 showed a plus 98 and was not significant and 2A2 was significant and that was 82.

The Witness: The variation among the five jars—that is the purpose of the statistical analysis. The variation among the five jars in 2A1 was decidedly more than the variation in the five individual jars, in 2A2.

Therefore, because they varied, as some of these in the pictures varied more than others, that variation was sufficient, that we couldn't say whether that gain of 98 in 2A1

was due to these variations or was due to the pres-
401 ence of the alfalfa bacteria, while in 2A2 the differences among individual tests was not great and the statistical analysis indicated that that difference was not due to chance but was due to the presence of the alfalfa bacteria.

2A3 shows a decrease of 62 milligrams but the difference is not significant. 2A4 shows a significant increase, 2A5 an increase, but not significant; 2A6 shows a slight increase entirely without meaning.

2B1 shows a slight decrease similar to 2A6 but in this case a decrease again entirely without meaning; 2B2 also a slight decrease. Note that both 2B1 and 2B2 were isolated in the 1920's.

2B3 shows an increase of 62 milligrams, a significant increase. 2B4 shows a very slight decrease; no significance.

Considering the averages that is, our averages of these 12 series,—the clover alone as compared to the clover plus alfalfa showed an increase of 39 milligrams where the alfalfa was present but this difference was not sufficient to say that the over-all comparison was significant.

The Court: In other words, you wouldn't be justified in reaching the conclusion that the addition of alfalfa
402 helped the product?

The Witness: No, but this—but you certainly could not say that it was inhibitive.

The Court: All right.

Q. (By Mr. Staley) Mr. Currie, have you analyzed the statistics in the Bond patent, No. 2,200,532?

A. I have checked the figures.

Q. Would you say, as a scientist and as one skilled in this art, that the statistics in the Bond patent show or demonstrate the correctness of a basic principle, concept or theory, whichever you want to call it, of inhibition of one strain of bacteria relative to another when it is placed in association with the other strain of bacteria?

A. In analyzing the statistics given in the patent I would not say that inhibition was demonstrated.

Q. Do you agree or not with the statement of Mr. Bond in his patent, on page 2, column 1, line 74, wherein it states:

"—this has not been done"

and that is with reference to mixed culture now we are speaking

"—because it was generally believed that one species produced an inhibitory effect on another species within
403 the same culture whereby symbiotic nitrogen fixation by the plant and the organism was inhibited or even prevented"?

A. No, I would not agree with that statement.

Q. Would you agree with the statement that, quoting from the patent:

> "It was for this reason it was considered desirable to use a culture containing a single species of organism rather than one containing a mixture?"

A. I would not agree with the statement.

Q. Mr. Curie, I now hand you a chart that I would like for you to identify, and with reference to that chart, analyze it with respect to the Bond patent and at this point I would like to first submit the chart for identification as Defendant's Exhibit 8.

(Said document entitled: Bond Patent No. 2,200,532; Nitrogen Fixed Per 10 Plants Clover, etc., was marked Defendant's Exhibit 8 for identification.)

Q. (continued by Mr. Staley) Now, Mr. Curie, with Defendant's Exhibit 8 in your hands, would you explain what those various columns and figures on there mean
404 and analyze that chart with reference to the statistical data that is given in Mr. Bond's patent No. 2,200,532, on page 6, first column.

A. This chart was prepared from the figures given in the last column of Mr. Bond's table on page 6 as to the milligrams of nitrogen fixed.

The Court: You mean in the first column?

The Witness: Yes, in the first column. When I said last column I was referring to the last column in the table rather than in the sheet of the patent, as the column entitled Milligrams of Nitrogen as per 10 plants.

The Court: Oh, I see.

A. (continued) These columns on the chart represent the best possible agreement,—the least possible variation Mr. Bond could have had between the individual jars in his tests.

Q. (By Mr. Staley) Let me ask you, first, Mr. Curie: Why did you use five columns in these various groups?

A. We used five columns because the patent states there were five jars in each test he produced and that the results were based upon the results of the five jars.

So we have drawn a column indicating the amount of nitrogen fixed in each jar, giving the most favorable
405 light that is possible from the standard deviation quoted.

The first column under Number 2, Non-Selected Strain represents the average. The next two columns under Number 2, represent the average plus the standard deviation.

Q. What do you mean by standard deviation?

A. That is the figure that Mr. Bond has given as his statistical analysis of his result. That is the variation of the standard deviation from the mean.

406 Mr. Staley: Q. What do you mean by "standard deviation from the mean"? Was it something up or down, or what?

A. That is the amount up or down from the average. It is a term used in statistical analysis. The two 125.5s represent the base yield of two of the jars.

The 105.5s represent the average minus, the standard deviation that he quotes.

Now, these differences might have been more among some of these, but that is the most—the closest agreement that he could have had.

On the next set, the five columns under "No. 3", the Selected Strain, the average nitrogen fixed was 140.3.

The last two represent the average minus the standard deviation, and is 108.7.

Column No. 4—

Mr. Staley: Just a minute.

Q. Mr. Curie, will you explain what that little green thing means on top of those columns?

A. Well, these two strains, while the differences were within the standard deviations, as he mentions it, the average differences in those two, that is the difference
407 between 115.5 and 124.5, No. 3, was 9 milligrams higher in fixation originally than 115.5. So if we want to make further comparisons, we must or should balance this original difference out of the equation.

Q. In other words, No. 3 had a head start on No. 2?

A. To begin with, I think it had a handicap, in other words, of 9 milligrams over the No. 2 or non-selected strain.

Going on to No. 4, which represents the non-selected strain plus alfalfa, the average was 74.3, the two columns of increase were 78.2 and the two columns showing the decrease or the minus deviation was 70.4.

Now, going over to No. 5, we have this selected strain plus alfalfa. The average here was 119.5. The deviation

was wider in this than in the others, which meant that the average plus the deviation went up to 159.2 and the average minus the standard deviation was 79.8. Now, if we balance out this 9 milligrams of difference between the two strains originally—

Q. The difference between two strains? Which ones are you speaking of?

408 A. Between 2 and 3, since 3 showed 9 milligrams higher fixation than 2, that difference should be subtracted from the fixation in 4, if you really want to compare.

Mr. Greer: Pardon me. I think you meant 5.

The Witness: Yes; if you want to compare 4 and 5.

So, if we take this 9 milligrams from this low yield of 78.8, we have a figure of 70.8 which is lower than the average he reports for the non-selected strain plus alfalfa. It is practically the same as the low figure that he has on No. 4. Now, this standard deviation meant that the two average might have been as high as or as low as he has indicated.

Therefore, in comparing 70.8, that might have been the true average in this test 5 when the difference between original strains was balanced out.

Therefore, to use No. 4 or No. 5 there would have been no difference in the actual quality of a culture produced, by using either one of these strains in combination with alfalfa. There might have been— The variation is within a limitation of error of experiment.

Mr. Staley: Q. If I understand you correctly, then, the probability of the deviation as set forth by Mr.
409 Bond's figures in his own patent, is such that by that laboratory deviation you could probably expect an average yield in No. 5 as well as 70.8?

A. You might expect a yield that low or you might expect a yield as high as 159.2. You might.

Q. Is there any way of guaranteeing one or the other?

A. There is not.

Q. Mr. Curie, what might you expect with reference to the unselected species when put in association with the alfalfa?

A. You might expect as low as 70.4 or as high as 78.2.

Q. Are the variations comparable?

A. Well, the variation in 4 is very much less than in 5, indicating that this strain 5, the selected plus alfalfa might give quite variable yields in the field.

Q. Mr. Curie, you were in the court room at the time Mr. Bond testified that while not directly employed by Agricultural Laboratories, yet he had been connected with them at one time or other?

A. He had—

Mr. Neuman: He did not so testify, that he had been connected with them.

Mr. Staley: Or at least he had been to the plant 410 or had some association with the personnel.

Mr. Greer: We accept the record. He testified that he was never connected with it; he visited them but never was connected with them.

Mr. Staley: Q. Do you know when Mr. Bond was at Agricultural Laboratories, Incorporated, at Columbus, Ohio?

A. I can't determine the actual days. It was early in June 1941.

Q. How do you establish that day or those days?

A. He was there a week or so preceding the seed trade convention of that year, which was held during the latter part of June, and further, I established that by a letter which I had written regarding that visit.

Q. I hand you herewith a letter written to Dr. H. W. Bachelor, Ohio Agriculture Experiment Station, Wooster, Ohio, and it has your name I. H. Curie at the bottom of the letter, and I ask you if you can identify that letter?

A. That is a carbon copy of a letter sent to Dr. Bachelor, on June 30, 1941.

Q. Did you write the letter?

A. I wrote the letter.

411 Q. That is a carbon copy, is it?

A. That is a carbon copy.

Q. Where has that carbon copy been since the date on the letter?

A. It has been in my correspondence file at Agricultural Laboratories.

Q. When was it removed from that file?

A. Immediately preceding this case at Quincy.

Q. And if I take you correctly, the carbon copy of that letter has been in your possession since the date it was written until it was removed from the file for purposes of use here?

A. It has.

Mr. Staley: I would like to present the letter that has just been identified by the witness, as Defendant's Exhibit Number 9.

412 (Said carbon copy of letter dated June 30, 1941,

addressed to Dr. H. W. Bachelor, Ohio Agriculture Experiment Station, Wooster, Ohio, from I. H. Curie, was thereupon marked as Defendant's Exhibit Number 9 for identification.)

The Court: Is the purpose of the letter just for fixing the date of Bond's visit?

Mr. Staley: For fixing the date of Bond's visit.

The Court: Maybe there is no question about it. When was it?

Mr. Rathburn: He said it was in June, 1941.

Mr. Staley: There is another point involved we want to establish with reference to this mixed culture, by this letter.

Mr. Greer: If they will admit that—

Mr. Staley: If they will admit that he was there in June—

Mr. Rathburn: Yes, he admitted it was in June, 1941.

Mr. Greer: He testified about June. The matter of whether it was the first or last part of June becomes essential, as we will show later on. Do you care to admit?

Mr. Staley: Do you care to admit that it was the
413 first part of June or the last part of June?

Mr. Varley Sherman Bond: I don't recall the part of June it was.

Mr. Rathburn: On the basis of that letter, we will admit that it was the first part of June.

The Court: All right.

Mr. Greer: The first part of June.

Mr. Rathburn: Will you let me look at that letter again? I missed the date on it. I am sorry. I thought the letter was dated early in June. It says June 30th. We don't know when it was.

Mr. Thiess: The letter is dated June 30th, which is the last part of June, so I don't think that we will admit he was there the first part of June. Maybe Mr. Bond can check it up.

The Court: Q. When was he there with reference to the time you wrote this letter?

A. He was there several weeks previous to the time I wrote this letter.

Q. You say that he was at your plant in June and you say several weeks previous to the 30th of June. Is that as near as you can fix this time?

A. Yes. I do know that this seed trade convention
414 in St. Louis intervened between the time he was there and the writing of this letter.

The Court: All right. Proceed.

Mr. Staley: Q. Mr. Curie, with reference to the Legume-Aid product, Plaintiff's Exhibit Number 1, which is the mixed combination culture of alfalfa and clover, can you state when that combination mixture was first produced and distributed by Agricultural Laboratories, Incorporated, of Columbus?

A. It was first produced— the first mix was made in December, 1940 and the goods was shipped out during January and February of 1941.

Q. Do you find in the letter that has just been referred to as Defendant's Exhibit No. 9 any reference to the mixed culture?

A. Yes.

Q. (Continuing:) Of alfalfa and clover?

A. There is reference to this mixed culture.

415 Q. You state that the mixed culture was introduced in December, 1940, to the seed trade?

A. It was sent out— or manufactured in December, 1940, and sent out in January and February, 1941.

Q. How do you establish that particular period of time of December 1940?

A. Because it was the year preceding the time that it was generally placed on the market and as a matter of fact, that letter was further corroboration of the time.

417 Mr. Staley: Take the witness, Mr. Thiess.

418 *Cross-Examination by Mr. Thiess.*

Q. Doctor Curie, I understand that after you left the Ohio University, you started in to work on agar culture bacteria, and so forth, at a state experimental station, is that correct?

A. That was Wooster College, my undergraduate work, not Ohio University.

Q. No. I mean after you got through with the University work?

A. I had already been employed at the Experimental Station seven years when I got my Master's Degree from the Ohio State University.

Q. What was the character of work that you did at that agricultural station?

A. We carried on various experimental work in the fields of soil bacteriology or soil biology, as it is termed.

Q. Well, can you specify what the type of work was, more specifically?

A. Yes. A good part of my work, in the first few years I was there, was devoted to the study of another nitrogen fixing bacteria which lives free in the soil
419 and not associated with the legume.

Q. And that was research work on that particular bacteria?

A. That was one of the things that I worked on.

Q. And what else did you work on?

A. As I stated, beginning in 1926, on the legume bacteria.

Q. Well, what was the character of the work that you did on the legume bacteria?

A. We, in 1926, carried on field experiments on the effect of fertilizing soy beans, the effect of this fertilizer on the nodulation and nitrogen fixation of soy beans. That was the first work.

Q. In other words, that was an investigation to determine the effect of fertilizer—

A. Yes.

Q. —in the field?

A. Yes.

Q. And did you do any other work in this—

A. Beginning in 1927 or '8 we began to test the commercial cultures, that is the products of the various companies which were selling inoculants in Ohio.

Q. And what inoculants did you test?

420 A. We tested Nitragin. Dickinson's—

Q. Will you give the trade names of these, if you know them, if you remember them?

A. Nitragin, of course, is a trade name.

Q. Of what company?

A. Of the Nitragin Company.

Nodogen is the product of Albert Dickinson Company. We tested also the products of the McQueen's Bacteria Company. This was known as McQueen's Inoculant.

There were others, some of which I can name and some of which I would not remember.

Q. Will you give me all that you remember?

A. There was Scott's Bacteria U NEED-R Inoculant. That was spelled U-N-E-E-D-R, as I remember it. And I am not sure of the first year. There was a Dry-Inoc put out by the Franklin Laboratories. We did test Urbana Culture Product of the Urbana Laboratories.

That is all I would want to state definitely. There may be others.

Q. And were these cultures all of the garden variety?

A. No. They were not all of the garden variety.

Q. Which ones of them were of the garden variety?

421 A. I do not know that any of those tests at the experimental station were of the garden variety.

Q. And were they all of single cultures?

A. Those named were, yes.

Q. They were all single cultures.

And you tested no garden variety of mixed cultures while you were there?

A. Not at the experiment station.

Q. And these tests that you made at the experiment station, were any of them nitrogen fixation tests, that you made at the laboratory?

A. If you mean by "nitrogen fixation tests" nitrogen analysis—

Q. Yes.

A. —there were nitrogen analyses run on some of the tests, on some of the results of the greenhouse tests.

Q. In these tests did you use control pots?

A. Yes. There were always control pots used.

Q. In other words, it is necessary, to run a proper test, to use a control pot, is it not?

A. We do use control pots.

Q. Will you kindly answer the question? Is it necessary, to get good results?

422 A. Yes, it is.

Q. Subsequent to this work that you did in the laboratories, I understand that you obtained a Fellowship at McQueen's, is that right?

A. I had my Fellowship financed and established by McQueen's.

Q. By McQueen's, and this Fellowship was where?

A. It was jointly at the Ohio Agricultural Experiments Station and the Ohio State University.

Q. What was the character of the work that you did while you were working on this Fellowship?

A. It was entirely work on the legume nodule bacteria.

Q. And what specifically was the work?

A. Well, it was a search for a good base or the best base that we could find.

Q. By that you mean the base to mix the medium in which the bacteria are placed?

A. Yes.

Q. In the inoculant?

A. Yes.

Q. And what was the result of this investigation? What did you find to be the best base?

A. As a result of that investigation, none of the 423 bases that McQueen's wished me to work on were satisfactory.

Q. And what were those bases, that were unsatisfactory?

A. The base that they were using was soil. We made various amendments to soil, by means of adding peat moss for one. I don't remember all of these any more.

Q. Well, give me, to the best of your recollection, the ones that you remember?

A. And one that we added was peat pulp.

Another was a mixture of peat with soil.

I believe there were several brands of peat moss and peat in there.

Q. And none of these were satisfactory, as I understand?

A. None of them were fully satisfactory.

Q. And as a result of that, what did you recommend as a satisfactory medium because of the work that you did on this Fellowship at Ohio?

A. I recommend—

Q. What did you recommend at the time?

A. I recommended that they go to an all-peat base.

May I amend the work of this Fellowship?

Mr. Thiess: All right.

The Witness: It was set up by McQueen's that 424 they wanted to use and that they wanted me to work on soil plus such amendments as might be found to improve it as a carrier. These various amendments, some of them did improve the soil as a carrier, but they did not meet what I thought was necessary to produce a good inoculant.

Q. And what was the medium that you finally recommended?

A. Peat humus.

Q. Peat humus alone?

A. Yes, that is, as treated with limestone, if an acid peat.

Q. Now, you were employed by McQueen's for how long?

A. For a period of somewhat over three years, from June 1934 until October 1937.

Q. And while you were employed by McQueen's, did McQueen's put ont any composite culture outside of the garden culture that you refer to?

A. No.

Q. And did they put out a single culture?

A. Yes, they did.

Q. Did they recommend and sell this single culture for field use?

A. They did.

Q. And the garden culture that is put out was sold
425 for garden use, was it not?

A. Garden and market gardens or truck gardens.

Q. And do you know why they made that distinction between the garden culture and the field culture, in that in the field culture they used the single species and in the garden culture they used a plurality of the species of the various bacteria?

A. That was a matter for convenience, for the user, I would say.

426 Q. Well, what do you mean by the convenience of the user?

A. Either a home gardener or the market gardener frequently wishes to plant peas, beans or lima beans and, therefore, for their particular use they liked this mixed culture. It was impossible to sell the home owner a separate culture for each one. Therefore, they were combined. The market gardener also found that combination desirable and wanted it in quantities to satisfy his needs.

Q. Well, if the mixed culture or garden type would be satisfactory for field use, wouldn't the farmer have been just as anxious to get the combination culture?

A. A mixture of peas and beans?

Q. Well, a mixture of the particular types of plants he was interested in.

A. No, not at that time.

Q. Why do you say "no, not at that time"?

A. Because the use of the mixed seedings had not grown, the demand for mixed seedings, as you call it, pasture mixtures, I call it hay mixtures, was not as wide spread as it developed later.

Q. I am not talking about pasture mixtures alone. I

am talking about inoculating seeds for fields and large acreages of these various legumes.

427 A. If a farmer wanted to inoculate alfalfa he bought alfalfa inoculant. If he wanted to inoculate clover, he bought clover inoculant.

Q. It is your position if the farmer at that time had been told he could get a combination culture of alfalfa and clover, he wouldn't have been interested?

A. Not unless he was sowing these mixed seedings I have referred to.

Q. I would assume, of course, he had been sowing these mixed seedings. Is it your position as an expert in the art that the farmer would not be interested in a combination culture at that time?

A. He may have been. I don't know.

Q. Don't you believe he would have?

A. No, I don't see why—

Q. He is today, is he not?

A. For mixed seedings.

Q. Also for use on his field cultures, is he not?

A. The farmer accepts the mixed cultures. He doesn't care, if he has ten bushels of alfalfa seedings, he is not interested in the clover in that package. He would just as readily buy a can labeled alfalfa only.

Q. In other words, it is your position that as far

428 as this art is concerned, they were not interested in a mixed culture for field use such as charged to be infringed here at the time we are talking about or the present time?

A. Who do you mean by "they"?

Q. I mean the farmer or the distributor or the manufacturer.

A. The distributor probably would have been.

Q. Well, how about the manufacturer?

A. Possibly so.

Q. Wouldn't you say absolutely so?

A. Yes, I would say the manufacturer would have said so.

Q. So that, as I now understand you, there was a real demand for one of these mixed cultures at the time you were working for McQueen, that is for field use, and no such culture was produced by McQueen?

A. I refuse to accept your statement.

Q. What is your statement? What would you say to that?

A. My statement is we had no request for such culture from the jobber, dealer or farmer.

Q. And are you of the opinion that there was no desire for such a culture?

A. There was none evidenced.

Q. I asked you whether you are of the opinion there was no such desire.

429 A. I know of no such desire.

Q. Then, as I understand you, it is your position that this mixed culture for field use, that is charged to be infringed and which is disclosed in the Bond patent in suit, wasn't used prior to Bond's—the issuance of Bond's patent because there was just no desire for it? Is that your position?

A. It is not.

Q. What is your position?

A. My position is that a majority of the single cultures at that time were none too good. It was difficult enough to produce a good single culture.

Q. When you say a lot of single cultures were none too good, which ones are you referring to? Will you please name them?

A. Oh, innumerable ones.

Q. I want you to be specific and give me the names of the single cultures that were none too good.

A. This U-Need-R wasn't generally satisfactory.

Q. What other ones? Give me all you know of that were not satisfactory.

A. McQueen's wasn't entirely satisfactory.

Q. What others?

A. There were Earp-Thomas single cultures which were not satisfactory.

430 Q. Any others?

A. There were Dickinson humus cultures which were not satisfactory.

Q. Give me all you can remember. Any more?

A. The early Dry-Inoc was not satisfactory.

Q. Any more?

A. There was a Mulford agar culture which wasn't generally satisfactory. That is, I believe, all I can name from memory.

Q. Can you give me any that were satisfactory?

A. Yes, there was Dickinson's Nodogen, an agar culture.

Q. That was a single culture?
A. Yes, on agar.
Q. Any others?
A. This Urbana culture, an agar culture.
Q. That was satisfactory?
A. Within the limits—it was satisfactory from the standards of that day. The Nitragin culture was satisfactory.
Q. Any others?
A. The Scott's bacteria was satisfactory.
Q. Who made that culture?
A. I don't know who made it. It was distributed by the Scott Seed Company.
Q. And those were single cultures?
431 A. Those were single cultures.
Q. Now, you had satisfactory single cultures on the market, some of them, as you have enumerated?
A. There were a few.
Q. And you were telling me when I broke into your answer that, as I understand it, that the reason that this composite culture didn't get on the market was because it was difficult with single cultures?
A. Yes.
Q. Will you continue with your answer, please?
A. These cultures were satisfactory on the basis of that day. I doubt if they would pass the more rigid test requirements of the testing laboratory today.
Q. When you say satisfactory as to the requirements of that day, will you be just a little more specific as to what you mean by that?
A. The tests used at that time in the various States were tests for nodulation only in general.
Q. And tests for nodulation are not satisfactory as to present standards?
A. Not completely, no.
Q. Nodulation doesn't tell you whether you are getting good results or not?
432 A. It doesn't guarantee you are getting good results.
Q. It merely tells you you are getting nodules?
A. That you have bacteria of the species named.
Q. Well, now, I wish you would explain again in just as few words as you can why you believe the mixed culture was not of any value in the early part or was

not demanded and then suddenly became in demand sometime around 1940.

A. A little earlier than that.

Q. All right, a little earlier than that. Tell me about it.

A. While I was with the Ohio Experimental Station it became the recommended practice of the men of that Station, staff, to recommend that any farmer who was planting clover seed should mix some alfalfa seed with that clover.

Q. You say that was a recommendation when?

A. It came along about 1930, I should judge, that their field results at the Experimental Station indicated it was a good practice, and they so recommended.

Q. How did they recommend it? Was that ever published?

A. Yes, I believe those reports are published.

Q. Can you refer me to any of those reports?

A. I cannot.

Q. Then it is purely a matter of recollection on your part at the present time?

433 A. At the present time, yes.

Q. That they made recommendations at that time to do what?

A. To mix alfalfa and clover seeds.

Q. All right. Will you continue with your story?

A. The result, as I observed in the field, that in place of having a crop of clover from which the farmer gets one good crop and then he gets a second crop, and that is all from the clover, if he mixed alfalfa seed with that, his first cutting looked principally like clover. There was some alfalfa in it. His second cutting of hay that same year would show a substantial increase in the proportion of alfalfa and, if he had been successful in getting a stand of alfalfa, he would have a third cutting and might keep that over for a second year or even a third.

This was recommended as a way of establishing alfalfa seedings which had been difficult. Therefore, it was recommended, and as is pretty well known, the farmer is a rather conservative individual, he doesn't always grab onto things in a hurry, but year by year there was an increase in the amount of these mixed seedings and at a meeting at the Experiment Station—this was after my day there—of the Ohio Seed Dealers Association, one of the members of the staff made a statement that sur-

prised me in stating that ninety per cent of the hay seedings are mixed seedings, that is, they contained
434 more than one kind of seed, and in these seedings were usually alfalfa and clover—there may have been several varieties of clover—and quite frequently some timothy.

In fact, a general recommendation was a seeding of four pounds of alfalfa seed, four pounds of red clover seed, four pounds of timothy seed and two pounds of Alsike seed. Of this mixture of seed—there is fourteen pounds—ten pounds of it is legume seedings, alfalfa and clover.

Now, it was generally recognized it was necessary to inoculate alfalfa seed if there was going to be any expectation of getting a stand.

Q. You say "it was generally recognized". On what do you base that?

A. Well, by farmer experience and Experiment Station work, they knew if they didn't inoculate, and bacteria wasn't present in the soil, they wouldn't get this stand I have been referring to. Clover had been grown for years. They would get a crop of clover. Checking up with various farmers indicated they would get an increase in the yield of red clover if they inoculated this clover, not a big increase necessarily, but one that would give them a very good return for the money invested in the clover seed.

435 Q. That would be very, very desirable, would it not?

A. Yes, it would be highly desirable.

Q. Continue with your story.

A. Consequently, most farmers inoculated the alfalfa, or they might think it was too much trouble and plant it anyway and fail. Very few would go to the trouble of buying a can of alfalfa inoculant and another of clover inoculant and inoculate the alfalfa seed and inoculate the clover seed and then mix them altogether.

Some farmers, however, would buy a can of each of the inoculants, mix the two inoculants together, and then inoculate the seed. In that way, the farmer was mixing inoculants and, so, by the time of 1939—I am speaking of Ohio where I am best acquainted—a very substantial part of the hay mixtures or pasture mixtures were mixed seedings and the mixed culture situation was a definite economic prospect.

Q. When did you say this was being done, this farmer mixing these two and putting them into the seed?

A. That occurred among farmers of my acquaintance as early as 1932.

Q. Well, in view of your story, you knowing about this, why was it that you never recommended to McQueen's or had them make a mixed culture of this kind so the
436 farmer would have a mixed culture?

A. I stated when I went to McQueen's, they were using a soil base which wasn't entirely satisfactory. It took me sometime to get the production of McQueen cultures switched around to where we had a good product. In fact, I had my hands full up until October 1937 that I was certain I had a good single culture and knew it had plenty of organisms in it.

Q. I understand you knew in 1932, about this advantage, the farmer mixing these things together as the farmer did, and the inconvenience that was resulting to the farmer from buying one or the other. There wouldn't have been any difficulty under those circumstances, if you knew about this, to suggest, "Why, we will mix these two together in a common culture", there wasn't any difficulty about it?

A. I have stated it was difficult to produce a satisfactory single culture and if you take two, a doubtful quality alfalfa culture and mix it with a doubtful quality clover culture, I have grave doubts of the value of the result-
437 ing mixture.

Q. In other words, they have got to be pretty well selected, these strains?

A. Not only that but they have got to be put into a pretty good base.

Q. But if the base is satisfactory for, say, an alfalfa culture, it would also be satisfactory for a clover culture, would it not?

A. Yes, it would.

Q. So, if you had an alfalfa strain in the base, it wouldn't necessarily affect the culture if you put clover in it, if the two would operate together satisfactorily with the proper selection?

A. Except the question of composition for the material in it to grow on. I have stated that McQueen's didn't have a satisfactory base. In other words, for each bacteria in the culture at that time, it would be my judg-

ment that there is a hundred in a culture of today. That may not have applied to the jelly culture.

Q. Well, you had your base in 1937, did you not, your satisfactory base?

A. Well—

Q. Did you make a recommendation at that time, 438 with a satisfactory base, to combine these two?

A. In 1937 I left McQueen's.

Q. Did you make a recommendation to anybody?

A. I did not.

Q. So that, you made no recommendation to combine these two at any time until after the Bond patent had issued, is that correct?

A. That is not correct.

Q. What is correct?

A. It is correct that I made such recommendation or suggestion in 1939.

Q. In 1939?

A. Yes.

Q. And what was that recommendation and to whom did you make it?

A. Not as a direct recommendation but as a suggestion that this seeding mixture would make such a product desirable and that it would be well for us to start work on such a product.

Q. And who did you make that recommendation to?

A. To Mr. Elmers and Mr. Erickson. I don't know necessarily whether I made the original suggestion or Mr. Erickson; I can't say which of the three of us did.

Q. And Uni-Culture was on the market at that time?

439 A. Uni-Culture was on the market at that time.

Q. Now, as I understood you, and I want you to correct me if I am wrong—did you say that the strains of clover and alfalfa that you have in your Legume-Aid are strains that you have been using for years?

A. Some of them are. Not all of them. Some of them.

Q. How many of them are?

A. I would say that three of them have been.

Q. Three of what?

A. Three of the alfalfa.

Q. How many of clover? Give me a statement on both of them.

A. Two or three of clover have been in use or have been isolated prior to 1938.

Q. How long prior to that?

A. I would have to check individual records to see when I obtained each culture in the collection or when it was isolated.

Q. You say three of the alfalfa?

A. I wouldn't limit myself to three. Two or three.

Q. Of both clover and alfalfa are old ones?

A. Yes.

Q. And how many of them are new ones?

A. As a matter of fact, there are none of them
440 new ones. There is one clover I isolated in 1938 and one in 1941 that may enter into our present cultures only.

Q. Then you have got five clover strains in your present culture?

A. No, I said two or three.

Q. Now, I don't think we understand one another. I would like to have from you how many clover strains which are in your present culture that you have used before you made this culture, old strains that you used in your single culture?

A. I do not limit myself to exactly the same strains at all times.

Q. Then you can't answer my question?

A. I use—there are four strains in clover, according to one greenhouse test that I find, and I may use three of those older strains and one new one or based on a more recent test until I have another test run, on the basis of new information—if I find a new strain that is better than what I have, I begin to use that new strain.

Q. And you have been changing these strains?

A. I have from time to time and expect to continue to do so.

Q. Both of your alfalfa and clover?

A. Yes.

Q. And you are doing that to improve the Legume-Aid culture?

A. I am.

441 Q. And where did you get these new strains from?

A. They are strains that I isolate myself in the majority of cases now. I may get a strain from Wisconsin or a strain from the Department of Agriculture. I am not—

Q. Well, do you go out in the field and get some of them?

A. Yes.

Q. And do you know whether or not some of these strains that you obtained in that way were strains that were the result of clover or alfalfa that had been inoculated with the Uni-Culture?

A. No, I do not.

Q. You don't know whether that was true?

A. I don't know of any strain that I have that—

Q. You don't know whether that is true or not?

A. No. The only clover that could—that has been isolated since the time of that patent was selected from clover plants along the roadside near Columbus, and the chances of that having been inoculated with a commercial culture are very slight.

Q. And how often have you changed your strains in this Legume-Aid? Do you do it every year?

442 A. Every year the recheck is made on the basis of the latest greenhouse tests. I may or may not change. If I have a combination that in my mind appears better—if one of my old strains has lost its vigor I will quit using it and use one that appears best at that time.

Q. Have you found a lot of strains that lost their vigor?

A. I have found a substantial number of strains that have.

Q. How many strains have you found that lost their vigor?

A. Oh, over my whole collection—

Q. I mean, since you have been working on these strains of this Legume-Aid that you took out because they lost their vigor that you talked about, how many of those?

A. I have probably discarded three or four clover strains from actual use.

Q. Because of their loss of vigor?

A. Because of their loss of vigor at that time.

Q. And how many alfalfa strains?

443 A. No alfalfa strains have been thrown away out of our collection. I suppose I have changed strains two or three times there.

Q. How many did you change because of loss of vigor in the characteristic of the strain?

A. I can't answer in a definite number, because that is done according to each test, each greenhouse test.

Q. Well, what I am particularly interested in, Mr. Curie, is to know since you put the Legume-Aid on the market how many strains of clover and how many strains of alfalfa you discarded because they lost their vigor?

A. And I can only say that I have changed the strains.

Q. You told me, did you not, that you took some of them out because they lost their vigor.

A. Yes, I have.

Q. Now, can you tell me how many you did take out on that basis?

A. I have stated that I cannot tell you exactly how many. I could by going back through the years of laboratory records.

Q. Well, can you say that there were a large number of them, say, five or six of each?

444 A. No.

Q. Or ten?

A. No, I would say two or three of each.

Q. That is your best approximation at the present time?

A. Yes, out of a total of eight or ten that have been used all told.

Q. Now, in the Legume-Aid that you make, do you make an efficiency test of the strains that are put into that before it is put on the market?

A. Those strains are made approximately once each year.

Q. Those tests, you mean?

A. Yes, the tests are made.

Q. And in that efficiency test do you make a test on the basis of nitrogen fixation?

A. On the basis of nitrogen fixation as evidenced by plant growth.

Q. In other words, you do it purely visually?

A. Not purely visually, by visually and plant weight.

445 Q. Then you do actually make tests, do you?

A. I do.

Q. To determine the amount of nitrogen that is fixed in the strains that you want to use, compared with the control plant?

A. Yes, I do.

Q. You always have a control plant?

A. I always have.

Q. And do you make any tests when you combine these

strains, before you put them in your culture, to ascertain whether or not there is any antagonism between the strains?

A. I do not, because I have never recognized such antagonism.

Q. You make no tests of that type at all?

A. I do not.

Q. Now, did you say that you have tested the mixed culture?

A. Yes, I have.

Q. And did you test that mixed culture in an efficiency test as compared with a single culture?

A. You are speaking of the finished?

446 Q. Yes.

A. Yes, I have.

Q. And did you find a difference in the results that were obtained when you ran these tests between the single culture and the mixed culture?

A. I did not.

Q. You found no difference at all?

A. Not in stimulation of plant growth or fixation as indicated by plant appearance, and plant weight.

Q. And that is the result of—

A. That is within the limits of error, as we determine it. No two tests will give exactly the same result.

Q. Well, within what limits of error do you place that?

A. Within this statistical error as used in here, which is the standard test indicating odds of nineteen to one. That is, the differences are not due to chance.

Q. Now, if I remember correctly, did you say that you could determine what amount of nitrogen is fixed, by observation, to the extent of 15 per cent?

447 A. I can tell whether the plant weight and the total nitrogen,—I believe I can estimate to that extent.

Q. Anything over 10 or 15 per cent?

A. In a difference of plant weight.

Q. Over 10 or 15 per cent, is that right?

A. Yes, I believe so.

Q. Now, would you want to say unqualifiedly, as an expert in this art, that you could do that, that you could say that there wasn't a difference of 25, or 20 or 30 per cent, without actually making a test and weighing it?

A. No, that error might run up to 20 per cent. Of

course, the only way a person could do that would be by repeated trial.

Q. The only way to find out is by weighing, is it not?

A. Weighing is the preferable way, although you do get within 20 per cent.

Q. You think you can get within 20 per cent?

A. I think I can.

The Court: Q. There was something said on the other side about an inhibitive strain in these plants, and
448 a non-inhibitive strain, and you don't feel that there is any such a thing as those two?

A. No, I testified that I have no belief in an inherent inhibitive action of one strain.

Q. Over another.

A. Because it is an inherent characteristic in the strain. There may be times when the yield will be down. I have one instance here in my own work in which the difference was low. The next time, that same strain, there was no appreciable difference, so whether to class that as an inhibitive strain or a non-inhibitive strain—because those tests do vary from one time to another.

Mr. Thiess: Q. Now, if I remember your testimony, you described tests of garden mixtures which you made while you were with McQueen's, and, as I understand it, those were purely visual tests.

A. Those were visual tests.

Q. And you enumerated there that you would do that visually by an increase of growth, the color of the growth, and what was the other one?

A. The size of leaf, which is also in general the
449 growth and color characteristic.

Q. In other words, your visual inspection is the size of the plant and the color, is it?

A. Yes; and, let us say, accurate with a plus or minus 15 per cent.

Q. And that is what you mean by plant inspection and growth inspection?

A. Yes.

Q. Visual inspection, I should have said. Now, as I understand it, you said you also made tests on a single culture in the garden mixture and compared that with using the mixed garden mixture as a culture, is that correct?

A. Yes. As I explained, we may have made a single

culture and a mixed culture from the same lot of bottles, in which case the culture would have been tested.

Q. And did you test those to compare them?

A. Only by this visual inspection, which, I may add, is the criterion used by most of the state testing agencies and also by the United States Department of Agriculture.

450 Q. They rely entirely upon the visual test, do they?

A. Most states rely on those.

Q. Which states, particularly?

A. New York, I believe, does. There are not too many states. Oh, the tests that have been run in Ohio were on that basis.

Q. And they do not make the nitrogen tests?

A. Not regularly.

Q. Well, they do make them if they want to be real accurate, don't they?

A. Yes, there are times that they are made. The United States Department of Agriculture uses this visual test.

Q. And uses the visual test for what purpose?

A. To check the relative efficiency of different cultures on the market.

Q. And you say they do not use the nitrogen test at all on the test of those efficiencies?

A. To the best of my knowledge the United States Department of Agriculture does not.

Q. And is it your contention that among scientists that is contended to be a proper and satisfactory test,

451 the visual test?

A. That would be indicated inasmuch as these tests are for the efficiency of the cultures, whether they gave satisfactory results or not. I would assume that they thought that they were.

Q. Well, do you believe personally that they give satisfactory results so that you can rely upon them to the extent of saying to the farmer, "You are going to get as good results out of this particular culture as you do out of another culture"?

A. Within these ranges.

Q. Well, you deem within a range of 20 per cent. That is a real range so far as the farmer is concerned, isn't it?

A. In most cases not too much so.

Q. In other words, you think the farmer is not interested in that last 20 per cent?

A. Oh, that is an increase. It is a worthwhile increase.

Q. That is what I am talking about.

A. But we are talking of clover here. For example—may I use a crop of clover as an example?

Q. Clover.

452 A. An average clover crop on fairly good land will run a ton and a half to two tons per acre.

Q. When you say on fairly good land, that means the average farm in this section of the country?

A. Yes, average or something above that, which is the type of farmer that inoculates.

Q. Well, wouldn't it be even more essential that the man that had the inferior farm should inoculate?

A. Unfortunately that is the reason he has the inferior farm, because he hasn't learned not only this but other modern farming practices.

Q. All right. Well, now go on.

A. In this clover affair that I have been interested in, I felt that if I could show a farmer a 10 per cent or less increase in his hay crop I would be doing him a good turn. If he had two tons of hay per acre and I could step it up 10 per cent, to 4400 pounds, if he got 400 pounds of clover hay from spending the price needed to inoculate the quarter bushel or less of seed that went on that acre, he has a very good return for his money. These wide differences that have been used for years to talk inoculation are rarely seen in the field, and I

453 have had one case called to my attention in the field where a farmer doubled or more than doubled his yield by inoculating clover. That was a farm—one of these that you were speaking about just now, that had been run down, and then the man put on phosphate and potash fertilizer and inoculated some of his field and some he did not. He did not have this big response that is publicized so much, and this publicity has been bad for the inoculant industry as a whole, because this 10 per cent increase that 95 per cent of the farms might get is not the one that shows up, but over the country would give a big increase in crop.

For the past two years—well, let's finish this. Now, here, if this man—I am talking of a 400 per cent increase, or a 10 per cent, 400 pounds.

Q. 10 per cent, yes.

A. Thank you. If he had a culture that was 90 per cent as good as that, he would lose 40 pounds of clover hay. Well, that is a loss, but he has that 360, and
454 under field conditions no one can control the result of the inoculation to that extent. During the past two years the American Soy Bean Association has been advertising strongly to the soy bean growers of the country to inoculate, and one year they publicized the fact that if one bushel per acre increase of soy beans was obtained by inoculating, the yield of soy beans over the country would be increased by a tremendous amount of bushels.

One bushel of soy beans would cost the farmer 10 cents to inoculate. One bushel of soy beans is worth a couple of dollars. So he has a good return. I have emphasized that sort of increase myself rather than these—I have seen one case where they inoculated soy beans that yielded ten times as much as the uninoculated. Well, now, to go out and advertise that generally and lead a farmer to think that he was going to double or triple his crop is misleading.

Q. Well, I was talking primarily about this 20 per cent.

A. Yes.

455 Q. And that 20 per cent is worthwhile, as I understand it, according to what you have just said.

A. This case that I have just quoted, if we take 20 per cent, the man has, without adding further bacteria to his soil, has two tons, or 4000 pounds.

Q. Per acre.

A. Yes. In one case he would have 400 pounds and in another—you say 20 per cent, which I put as the absolute limit, the average would be substantially under that—if he had a 20 per cent, it would be 80 pounds. Yes, that is worthwhile, but as compared to the general increases it doesn't rank up in the way of stating 20 per cent of the man's total crop, because his clover crop is not going to be a failure if he does not inoculate at all. We are talking in terms of total crops, of 20 per cent.

Q. But if there is that difference in two inoculants it would be worthwhile to use the inoculant that gave you the extra 20 per cent, 10, 15 or 20 per cent.

A. If that difference is significant and will be repeated.

Q. That is right.

A. You say 20 per cent. My own figure is 10, 15;
456 in other words, 40 pounds.

Q. I thought you said 10, 15, and it might go up to 20.

A. Yes. You quote one extreme and allow me to state my own minimum of 10.

Q. I am taking it over the entire average. Now, these tests that you made on the garden mixture with the single strains with single strains of some of the bacteria in the mixture at McQueen's and where you tested it visually, you haven't got any records on that, have you?

A. No, I do not have.

Q. This is your best recollection of that?

A. Yes. In other words, we never noticed differences between the two.

Q. And that is purely a proposition of recollection on your part at the present time?

A. That is.

Q. Now, you also referred to the fact that you made a count of the number of bacteria in the garden culture made at McQueen's. That is correct, is it not?

457 A. In the bottles used in preparing that culture, garden culture.

Q. Well, how did you make that count?

A. By the standard plant test, Petri dish.

Q. And do you remember what that count was as to each one of those bacteria?

A. Within a reasonable range.

Q. Well, give me the best of your recollection, will you?

A. The clovers would run up to around 300,000 per pint bottles.

Q. Can you give it to me in bacteria per cubic centimeter?

A. No, because I measured it on the basis of the count in a bottle.

Q. You never got the number per cubic centimeter, or we could calculate that from the bottle. It is a pint bottle, is it?

A. Well, that is the total in this bottle which has a slope of jelly in there. It is a pint bottle. There is less than one-fourth of that capacity of agar. It is in terms of the surface, not in a volume comparison there at all.

458 Q. Well, did you make any count of the bacteria in the solution?

A. No, we did not.

Q. You never made any count of that?

A. No.

Q. So you did not know how many bacteria you would actually have in the solution that you added to the humus, or whatever your medium was in your garden culture.

A. Not in one individual lot. We were basing our run on the average number of bacteria that we had in the bottles.

Q. Well, then you had no accurate count of how many bacteria there were in each one of these legumes of mixed garden culture?

A. No accurate count.

Q. Well, you have referred in your direct testimony to the manner in which you made this garden culture at McQueen's. That is correct, is it not?

A. Yes.

Q. Now, are there any written records as to how this was done?

459 A. There are not.

Q. This is also a matter of your recollection?

A. Simply a matter of following the standard procedure.

Q. And your recollection as to how it was done?

A. Yes.

Q. Now, you ran some tests—let me put it this way: What were the first tests that you referred to? Did you run some tests at McQueen's?

A. On what?

Q. Tests comparing the strains of these bacteria?

A. The individual strains before they were used in the culture?

Q. Yes.

A. Yes.

Q. You haven't got the record of those tests?

A. No.

Q. Now, then the next set of tests that you referred to, if I remember correctly, were the tests that you ran at the Agricultural Laboratories, is that correct?

A. Yes, I have run further tests there.

Q. Now, what was the first set of tests that you ran and that you have referred to in your testimony at

460 the Agricultural Laboratories, do you remember?

A. The first set of tests I run?

Q. The first tests that you described in your direct testimony.

A. Well, that is again the comparison of the garden mixture as compared to a single culture prepared at the same time.

Q. And you ran a test of that kind at the Agricultural Laboratories?

A. Yes.

Q. Have you got the data on those tests?

A. I do not have.

Q. Is it available anywhere?

A. No, it is not, I don't believe.

Q. So whatever you have told us on that is also a matter of your personal recollection only?

A. That is.

Q. Now, as I remember, the next tests that you ran were the tests on strains of clover and alfalfa, alone and in combination, which tests were run for the purpose of this suit, is that correct?

A. That is correct.

461 Q. Have you got the data on those tests?

A. I have.

Mr. Thiess: I will ask counsel if he will kindly produce this data so that we can have it for inspection at further cross-examination.

Mr. Greer: I have no objection to producing them at all.

462 IN THE DISTRICT COURT OF THE UNITED STATES
Southern District of Illinois
Southern Division

Q. Mr. Curie, do you remember that you told Mr. Bond in 1941 that you were not able to find any inhibition in tests which you conducted on mixed cultures?

463 A. I do not.

Q. You don't remember making any such statement?

A. No.

Q. You don't remember talking to Mr. Bond about that at all?

A. No, not in regard to inhibition tests.

Q. Now, referring to the tests which are tabulated on

Defendant's Exhibit 5, did you use uninoculated control pots in these tests?

A. What is the number, Number 5?

Q. Here (handing paper to witness).

A. Yes; there was a series of uninoculated controls.

Q. Do you have any pictures of these uninoculated control pots?

A. I do not.

Q. And why didn't you take any pictures of those?

A. Because the plants had died or were in a dying condition and were so low that they couldn't be seen above the rim of that jar.

Q. And that was true of each and every one of them?

A. Yes; there may have been one that would have been to the level of the top of the jar.

Q. And you made absolutely no effort to have a
464 pictorial representation of those available?

A. No, I didn't have them photographed.

Q. Now, have you given us the test data on these control pots?

A. The test data?

Q. Yes.

A. Yes.

Q. The test data on the control pots is included in the data you gave us?

A. Yes.

Q. Can you point out where that is in the data that you gave us?

A. Row 28.

Q. Which one? Will you point it out to me?

A. Check (witness indicates on document).

Q. Row 28. That is your control pot?

A. Yes.

Q. And will you do likewise for this set of data?

A. In that set of data as in the report submitted the plant growth was so low and the plants were dead at the time, that it was impossible to harvest outgrowth from them and accordingly there was no growth taken on those controls.

465 Q. So you had no data on your control to compare it with at the end?

A. I had no weight record. Those reports are weight of tops.

Q. Now, the ones that you have no control records on

are the ones in which the data is tabulated on Defendant's Exhibit 7?

A. Right.

Q. Now you stated, as I understand it, that one pot in this series, 2A6, was probably contaminated with a good strain. That is correct, is it not?

A. Probably.

Q. And if that is the fact, how do you know that the jars in the lower series of that picture were not also so contaminated?

A. In comparison with this, one of them may have been.

Q. How do you know that more of them may not have been?

A. Because in any series of this sort the principal use that I have for controls is to check your percentage of contamination.

We all do have controls which do get bacteria in them from external sources beyond our control and those will happen and therefore we have those controls to see
466 whether those do appear.

Q. But in this picture, Defendant's Exhibit 6-G, the jar in the upper row which you say was contaminated, according to my visual inspection is about the same as the ones in the lower row, is it not?

A. It may have been contaminated is my statement.

Q. If that has been contaminated, isn't it possible that you have got the growth which is in the lower rows about the same by the same contamination?

A. It is beyond all limits of probability that such a thing would happen.

Q. But you don't definitely know?

A. One chance in a million, I would say, or less.

Q. You will admit that as far as a visual inspection goes, the growth on that one plant that you say is contaminated in the upper row is about on a par with the better plants in the lower row, is that correct?

A. Approximately so.

Q. Now, what training, if any, have you had on the application of statistical analysis to figures of this kind?

A. I have had no course work in such.

Q. And to what extent have you used this statistical analysis? What do you know about it?

467 A. I have used some of the older types, before 1933.

Q. What method of statistical analysis did you use in analyzing the results in the tests of Defendant's Exhibit 5?

A. What is known as Student's method.

Q. And can you just explain generally what that method is?

A. It is a method— I do not pretend, let me say, to be a specialist in statistical analysis as I have stated.

Mr. Thiess: I appreciate that.

A. (continued) This T test, Student's T test, is the term used, is a method by which you compare the standard error between the two means under comparison with the difference between those means, and the result is expressed in the odds that such difference did not occur by chance.

Q. (By Mr. Thiess) And do you know of any place where that test is used for statistical analysis in biological work?

A. It has been used to quite a degree.

Q. You know that it has?

A. I have seen it used.

Q. Do you know of any scientific laboratories that use it? Could you tell me any that you know of? Do
468 the universities use it for this work in biological determinations of statistical analysis?

A. It is used in certain types of work at Ohio State University.

Q. And what was the standard error of your determination in applying this statistical analysis?

A. The standard error is not written out in the run thru the formula. The formula expresses a ratio.

Q. So that this does not give a standard error and you haven't given it to us in the table?

A. No; it is not given in the table.

Q. And you would not know what the standard error would be in applying your test?

A. I did not calculate standard error individually in this case. I can do so.

Q. Now, in the tests that you submitted in Defendant's Exhibit 5, I understand they were only conducted on clover, is that correct?

A. That is correct.

Q. Did you make any tests on mixtures on alfalfa plants?

A. We did not.

Q. Can you tell me why you did not?

A. Limitation of time and labor available for tests.

469 Q. It would be just as essential to conduct the tests of alfalfa as it would be on clover, would it not?

A. If there is such a thing as inhibition. Pardon me; if you want the standard error of the difference, they are here.

Mr. Thiess: Thank you very much.

Q. (By Mr. Thiess) Now, on Defendant's Exhibit 7, does not the test on Strain 202 demonstrate significant inhibition between clover and alfalfa? Have you got that exhibit up there?

A. I have it right here. It shows a significant reduction in yield when alfalfa is present in this test run at this time.

Q. Well, that does show that there is inhibition,

470 does it not?

A. No, it does not.

Q. Why not?

A. Because in the other test of the same strain at a different time under different light conditions no inhibition appears. There is no significant difference between the averages.

Q. And which is the other strain on this test that shows that?

A. Exhibit 5, I believe.

Q. Which one is that, on Exhibit 5?

A. Strain 202.

Q. The second one from the top?

A. Yes.

Q. That is the one you corrected?

A. Yes.

Q. And you say they were run under different conditions. What are the different conditions under which these two were run?

A. Time of the year—

Q. Is that all?

A. —which constitutes a very different condition in the light to which these plants were exposed, for one thing.

471 Q. In other words, one was started when, that is, Exhibit 5?

A. In chronological order, Exhibit 7 was started on January 27, 1944.

Q. And ran until when?

A. Ran for slightly over two months.

Q. And with respect to the one on Exhibit 5?

A. That one was started October 27, 1944.

Q. And ran until when?

A. That one ran for about three months, to approximately the end of January.

Q. And you have used the same strains of both clover and alfalfa in both of those tests?

A. As explained in the first one the alfalfa was a mixture of four strains which we use in manufacturing our culture.

Q. In the first one, that is the one on which Exhibit?

A. Exhibit 7.

Q. Yes; and the one on Exhibit 5 used how many strains?

A. 12 strains.

Q. And did the 12 strains in the test on Exhibit 5 include the four that you used in the run on Exhibit 7?

A. They did.

472 Q. And you wouldn't say that the addition of these other strains might have caused that inhibition rather than the light? You don't believe there is any possibility of that, is that correct?

A. There was no inhibition in the second test where the 12 strains were present.

Q. When you took out some of those strains and used four of them, you did get inhibition?

A. No, the first test was run with four strains.

Q. Yes.

A. The first test was run with four alfalfa strains present and we had this reduced yield on Strain 202.

Q. Yes.

A. In the second test 12 strains were included and no inhibition occurred.

Q. And even though you made that change between the two, you don't think that that had anything to do with the difference in results, that this difference in results is due absolutely to light; is that your position?

A. I absolutely do not say the difference is due to light. That is a great difference that occurs at that time, different seasons of the year. The same 4 strains were present in both tests. Other strains were put in in
473 the second test.

Q. Then you do not know at the present time definitely why that difference occurred?

A. I do not.

Q. Now, is it your opinion that scientific work in this biological art in connection with bacteria for inoculating legumes outside of this country is of no value?

A. No; it is of value.

Q. And isn't it true that the original discovery of legume bacteria and their practical use was made by a German investigator?

A. It is true.

Q. Then would you consider that the publication by Mr. Kronberger that has been put into evidence, is not valid?

A. Not because Mr. Kronberger is a German nor anything of that sort, but I do not believe that Mr. Kronberger has proven inhibition.

Q. In other words, you feel that the data that is contained in his paper does not show or prove inhibition?

A. That is correct.

Q. In other words, you interpret the paper as not showing inhibition?

A. I do.

474 Q. Now, referring to this Defendant's Exhibit 8, am I correct in saying that the columns represent conjectural data and not actual measurements?

A. Mr. Bond did not submit his original figures. Those are the most favorable interpretations that can be given his results.

Q. Those are conjectural interpretations you gave to his figures?

A. They are.

Q. Do you understand how the law of the standard deviation of the mean is determined?

A. Yes, I believe so.

Q. Can you just generally tell me how that is done?

A. Through two ways which reach the same place. The one method is by subtracting each individual determination from the mean and then squaring—I would not attempt to be accurate on the formula.

My memory is that these deviations, each individual difference taken and squared; this divided by the number of determinations, minus 1; that is, if there were five replicates, and the square root of this quotient taken,—I would not wish to be taken that that is an absolute—

Q. Did you utilize that in applying changes on 475 your chart, Defendant's Exhibit 8?

A. I utilized only the figures that he gave for said standard deviation.

Q. And am I right that th columns that appear on this sheet represent differences based on adding to or subtracting from the average, the standard deviations?

A. That is correct.

Q. Is it your understanding that the standard deviation of the mean is the average difference of the replicates from the mean?

A. No, it is not.

Q. Did you use that in this chart, Defendant's Exhibit 8?

A. That standard deviation— In other words, when you have a mean of five determinations, the most favorable interpretation of that that you could have to give the least standard deviation, would be where two of the determinations were above the mean by exactly the standard deviation and two of them were below the mean by exactly the standard deviation. That is the representation in that chart.

Q. Do you consider that that is an accurate method of comparing such data to apply the standard deviation of the mean? Is that your position?

A. It is the best that could be done from the data 476 at hand.

Q. Now, when there is no significant difference between two means, is it statistically correct to assume that this difference is a real difference instead of just an apparent one?

A. No; it is not correct.

Q. On what basis, then, could you transfer an insignificant difference between two means from one series of columns to another series of columns, as you have done in the chart, Defendant's Exhibit 8, as represented by the green portions?

A. Because they had been included in the comparison in between 4 and 5; they are there.

Q. Now, do you consider the green portion at the top of column 1 under Number 3: Selected Strain, a significant difference as compared with the first red column under Number 2: Non-Selected Strains?

A. No; the difference in average; statistically, was not a significant difference.

Q. Now, I am correct, am I not, in stating that the Series Number 3 and 5 on your Exhibit 8 represent concurrent tests using particular strains of clover, Series 3 alone, and Series 5, mixed; that is correct, isn't it?

477 A. They were so presented.

Q. And that is the way you presented them here?

A. Yes.

Q. And isn't it true that the nitrogen yield obtained in Series 3 and Series 5 is entirely independent of the clover strain used in Series 2?

A. Yes.

Q. Then what possible justification is there in your subtraction of the green portion, the difference between the average in 2 and 3, from the columns, Series 3 and 5?

A. Because the indication there, those two strains,—if you want to make a comparison such as has been done there it isn't fair to start out with strains which show that much difference, statistically significant or not, in order to reach a conclusion over there.

Q. Of what difference,—how much difference? Do you mean this difference in column 1?

A. Yes.

Q. Didn't you just tell me that that wasn't significant?

A. It is not statistically significant and yet it is a difference, in presenting it to interpret this result.

Q. Supposing you had a difference in that strain which went halfway down or, say, three fourths of the way

478 down on column 2, Series 3, and you applied that to Number 5, you would practically be feeding nitrogen into the air; you wouldn't have anything left here, would you?

A. That could be possible.

Q. That is on the basis of your calculation, that could be possible, is that correct?

A. Yes.

Q. I want to ask you this again now: You understand, of course, that the tests, Series 3 and 5 of the patent, are tests entirely separate and distinct from the tests of Series 2?

A. They are being compared with Series 2.

Q. But will you answer my question?

A. They were run separately, yes.

Q. They are distinct and separate tests, are they not?

A. Yes.

Q. Now, when was this LEGUME-AID made by the defendant company ready for distribution by the defendant company?

A. There was one lot made in December, 1940 and distributed in January and February, 1941.

Q. And if I understand it correctly, that distribution was sent out as a field test, is that correct?

A. That was sold; not sent out as a field test.

479 Q. Didn't you send it out to get a field test?

A. We sent it out into one state; all of the alfalfa and clover culture that went into one state that year was this lot of culture.

Q. And was that sent there for a field test?

A. It was sent there to get field results.

Q. And then subsequently you did announce that this LEGUME-AID was for sale to the trade, did you not?

A. Yes, we did.

Q. And that was after this field test and when was the date that you made this announcement?

A. The announcement was made before we had any results of the field test at the Seed Trade Convention, at St. Louis, in the latter part of June, 1941.

Q. Now, referring again to Defendant's Exhibits 5 and 7, were any of the strains reported on in these tests, strains that are used in the commercial culture of the defendant, of LEGUME-AID?

A. The strains used in LEGUME-AID are all included in this test.

Q. Can you point out which ones they are?

A. No; I can't point out which ones have been used in that lot or in a particular lot.

480 Q. You don't know which of the strains which are contained on Defendant's Exhibits 5 and 7 are strains that are used in the commercial article?

A. Yes, but not in any particular lot.

Q. What do you mean by any particular lot?

A. For example: That package—I can't tell that strain. 2A2 is contained in that package.

Q. How often do you change your strains?

A. As I said, I may change them— They are revised and if I find of the ones I have been using one of them has deteriorated it may not be thrown away from the collection but it isn't used in the test after that time.

Q. Do you change these strains as often as once a year?

A. That is about the frequency that I am able to run greenhouse tests.

Q. These tests which were made in 1944? Can you give me the strains in your commercial article that you used in the year 1944?

A. I can give you some of them. 2A5 was used; 202 was used; 2A3 was also used.

Q. And that is all you remember, at the present time?

A. That would be probably the ones that were used following this test.

481 Q. And how many of these strains that are shown on these two exhibits, Defendant's Exhibits 7 and 5, are old strains that have been used by your company for a long time?

A. Well, 201 has been in our possession for a number of years; 2A2—

Q. When you say a number of years,—can you make that a little more specific?

A. Some of these I obtained as early as November, 1934.

Q. Can you tell me which ones of those they were?

A. No; not with certainty, I can't. Some of them were received; some of these I just kept through after 1937; I think one of these may have been obtained in 1940 or 1941.

These dates are the dates at which they were put into a pure culture collection and have been a matter of record since that time.

Q. And some of those strains may have been obtained within the last year or so?

A. No, none of these.

Q. None of those?

A. The latest here are 1941.

Q. And do you know how many of those strains would be within the year—

482 You gave me the isolated year here.

A. That means the isolated year here, yes.

Q. Does that mean the year you got it?

A. If it was my own testimony, yes, it refers to the original year the culture was made; that indicates how long that it has been in existence as a pure culture.

Q. Since that time?

A. Since that time.

Q. Are the strains of Defendant's Exhibit 7 the same as of Defendant's Exhibit 5?

A. They are.

Q. Now, I would like to ask you, Mr. Curie, when you have used in your testimony nitrogen fixation tests you mean tests for dry weight or tests in which the nitrogen content of plants is determined by a chemical analysis.

A. I mean tests of dry weight except as this one series of nitrogen analyses are presented here.

Q. In other words, this one that you say represented here is shown on what exhibit where you use chemical analysis?

A. On Exhibit 5 the final two columns refer to nitrogen.

Q. And you made no other chemical analysis except that one.

A. That is all I have made on these cultures.

483 Q. That is the only one you have ever made?

A. On these cultures, yes.

Q. Now, had you ever evaluated the effectiveness of your commercial mixed cultures on the basis of the dry weight determination prior to 1944?

A. I think such tests were made. I did not run them myself.

Q. You don't know of any, personally?

A. No; not of personal experience.

Q. And you were in charge there so you would almost think you would know, wouldn't you, if the tests were run?

A. I have stated I was not in charge at the time I went to Agricultural Laboratories.

Q. You mean before you got your present position you think such tests may have been made?

A. A test run on the mixed culture?

Q. Yes, on a mixed culture?

A. I don't know. No—

Q. No tests were made of that type prior to 1944?

A. No.

485 LEWIS W. ERDMAN, called as a witness herein on behalf of the defendant, being first duly sworn, was examined, and testified as follows:

Direct Examination by Mr. Staley.

Q. Will you please state your name, your age, and your present occupation?

The Witness: A. Lewis W. Erdman; age 49; present occupation, Director of Research and Production for The Nitragin Company, Milwaukee, Wisconsin.

Mr. Staley: Q. Would you please state your education and your general experience in this field of plant pathology and bacteriology?

A. I received my Bachelor of Science Degree in the Maryland State College of Agriculture, in 1916.

For two years, from 1918 to 1920, I was on the staff of the Maryland Experiment Station, and in the next three years I was on a Research Fellowship at the Iowa Agricultural Experiment Station.

At the Iowa State College, I received my M.S. De-
486 gree in 1921, and in 1922 Ph.D Degree. The year after graduation from Iowa State College, I was on the National Research Council Fellowship at the Washington State College, and from 1923 to 1927 I was Assistant Professor of Soils and Assistant Chief in Soil Bacteriology at the Iowa Experiment Station and College.

1927 to 1928 I was Professor of Soil Technology at the University of Maryland, and since 1928, in November, I have been in my present position.

Q. You have been Director of Research at The Nitragin Company since 1928?

A. That is right.

Q. Dr. Erdman, as Director of Research of The Nitragin Company do you come in contact with any of the advertising literature of The Nitragin Company?

A. Yes, since I have been with the company, I have a very close contact with it and O.K. it and usually supervise the production of it.

Q. Could you recognize an advertisement of The Nitragin Company, if it was put in your possession?

A. I could.

487 Mr. Staley: Q. I hand you herewith an advertisement entitled "NITRAGIN FACTS THAT BEAR

GREAT WEIGHT", and ask you if you can identify that as an advertisement of The Nitragin Company?

A. This is a catalog of Nitragin prices, dated 1923. It gives miscellaneous cuts, price cuts and other information. Although it was put out before my coming to the company, I recognize the registered trade name, the can and other advertising material which we are using at the present time in many of our advertisements.

Mr. Staley: If Your Honor please, I would like to identify, if opposing counsel agree however, a photostatic copy of the advertisement that has just been identified by the witness. As Defendant's Exhibit Number 10.

(Said photostatic copy of advertisement headed "NITRAGIN FACTS THAT BEAR GREAT WEIGHT", dated 1923, showing prices of The Nitragin Company, Inc., of Milwaukee, Wisconsin, and
488 giving miscellaneous cuts, price cuts and other information, was thereupon marked as Defendant's Exhibit Number 10 for identification.)

Mr. Staley: Q. Dr. Erdman, would you look at that advertisement and tell us if there is any item of product, or any product on there indicated as a mixed culture as it has been identified in the course of this trial?

A. Yes. On the inside page, near the bottom, is noted Garden Size Inoculation three-in-one for peas, sweet peas and beans.

The Witness: Also in the center of the page is a cut, advertising garden Nitragin for peas and beans. At the bottom of the large ad, on the inside page, garden packages listed for peas, beans, sweet peas, and the same is true on the opposite side of the page.

Mr. Staley: Q. These items or these references that you have made are to a mixed culture for peas, sweet peas and beans as identified on the exhibit, is that correct?

A. That is correct.

489 Q. Has this product been manufactured by The Nitragin Company since the time you went with The Nitragin Company in 1928?

A. Yes. It has, but since this price list was published, we have included several other strains belonging to different cross-inoculation groups.

Q. Have you ever tested the garden mixture as it is referred to here in the advertisement?

A. Yes. In our routine tests, we have made tests of samples of garden size Nitragin on all of the legumes, for which it is intended.

Q. Have you made tests on the individual strains of the cross-inoculation groups that are included in this garden size inoculant?

A. Yes. All of these strains are tested before we use them in our commercial production.

Q. You make mention of tests. Will you tell us what kind of a test you apply to the single strains of bacteria, to determine their efficiency?

490 Mr. Staley: Q. (Continuing:) Will you please add to that question, whether you tested these single strains of the cross-inoculation groups prior to August 24, 1938, that is the filing date of the Bond Patent?

A. Yes, we have tested them prior to that date. We have since tested them, since that date.

Q. More than two years prior to that patent—

A. Oh, yes.

Q. —the filing date of that patent which was referred to now?

A. Yes.

Q. Will you please let us know the variety or type of test that you applied to these single strains of bacteria prior to the filing date of the Bond Patent or two years prior to that date?

A. Those tests are vegetative tests.

491 The Witness: Vegetative tests, using the legume: for instance, on peas, we will test these strains of pea bacteria with the idea of making a selection to get the more effective strains. In the majority of cases, this test need not go much further than just a vegetative test, which indicates, growing the plants in a sterile sand to which a nutrient solution has been added, everything except nitrogen. That is, we usually always will run a control in an uninoculated batch of seeds for comparison. For most practical purposes, we can get, by running a bunch of strains along at the same time, very brief comparisons from which we are able to make a selection.

Mr. Staley: Q. Would you say as a scientist, as one experienced in this field of plant bacteriology, that the vegetative tests are indicative of the percentage of nitrogen that is fixed in a plant?

A. It is an indication, yes. It doesn't tell you how much, but it is an indication.

Q. Did you ever, prior to the Bond Patent, or two years prior to that date of August 24, 1938, make any actual nitrogen determination tests, or run any nitrogen determination tests on the single strains of bacteria
492 that you had in the garden mixture?

A. Well, I am pretty sure that we had some tests along about 1935, '36, when we set up our nitrogen determination apparatus, but I wouldn't have those tests available.

Q. But you did make nitrogen determination tests prior to 1938?

A. Oh, yes; we have done that.

Q. On the individual strains—

A. On the individual strains.

Q. —of the bacteria that went into the garden mixed cultures?

A. Yes.

Q. Did you ever make any comparison tests between the individual strains of the bacteria that were in the mixed garden culture and the individual strains?

A. Not running at the same time, no.

493 Mr. Staley: Q. What strains were used, what strains of bacteria were used in the mixed garden culture, with reference to the stock of cultures that you had of these same varieties?

I am asking the witness what type of strains of bacteria went into the mixed garden culture with reference to the stock cultures of the various strains of, such as peas, beans, that they had in their stock culture?

A. In preparing our garden culture, we will use the same material for our regular production of pea culture, for instance, that is used by the canners or the seed pea growers; the same selection of strains that goes to make up that also goes into the production of our garden culture. The same is true for our bean culture. The same is true for our lima bean culture and lupine culture. All of these are included in our garden mixture.

Q. Doctor Erdman, I hand you herewith a sample of a product and ask you if you can identify it?

A. This is a package, can, garden size Nitragin for garden peas, garden beans, sweet peas and lupines, marked "Good until December 31, 1935."

494 Q. I also hand you herewith a set of photographs and ask you if you can identify those photographs, with reference to the sample that you have identified?

A. This looks like an exact photograph, on the top label.

Mr. Staley: If Your Honor please, I would like to submit the photographs that have just been identified by the witness, as being photographs of the sample, and have the photographs identified as Defendant's Exhibits.

I will introduce the photographs identified as Defendant's Exhibits 11-A, 11-B, 11-C and 11-D.

(Said photographs were thereupon marked as Defendant's Exhibits 11-A, 11-B, 11-C and 11-D, for identification.)

Q. Dr. Erdman, would you say when the sample of the can that you identified was produced?

A. This can of inoculant could have been produced any time between December 1st, 1934 up to and through October 31st, 1935.

Q. How do you establish that date?

A. Knowing the expiration date and knowing the time that we start to produce and cease producing culture for this given year.

495 Q. That is the same information as on the can, is it not?

A. Yes. That is the same information on the top cover.

Mr. Staley: I would like to have the can, which has been identified by the witness previously, presented for identification as Defendant's Exhibit No. 12.

The Court: All right.

(Said can labeled "NITRAGIN" of The Nitragin Company, Inc., Milwaukee, Wis., was thereupon marked Defendant's Exhibit No. 12 for identification.)

Mr. Staley: Q. Dr. Erdman, did you run any tests on nitrogen fixation with reference to the question of determining whether or not one strain of bacteria was inhibited with another, when it was put into association with the other strain?

A. Yes, I made such a test last Fall.

Q. Did you make a report of that test?

A. It hasn't been reported yet, no.

Q. Did you make any report at all?

A. You mean to a scientific publication or something?

Q. No, not to a scientific publication, but did you collect the data and compile it into a report?

496 A. Oh yes, I have such a report on those results.

Q. I hand you herewith a report and ask you to identify that.

A. This is a report of an experiment which I set up last Fall, to answer the question, if possible:

"Does one species of legume bacteria produce an inhibitory effect on another species within the same culture?"

This is the report prepared by me.

Mr. Staley: If Your Honor please, I would like to submit the report and have it identified as Defendant's Exhibit Number 13.

(Said report of Lewis W. Erdman headed "Does One Species of Legume Bacteria Produce An Inhibitory Effect On Another Species Within the Same Culture?" was thereupon marked as Defendant's Exhibit Number 13 for identification.)

497 Mr. Staley: Q. Dr. Erdman, will you please tell us the manner in which you set up your laboratory test and the procedure that you follow in obtaining the results that are presented on this report?

A. In this report, a selection was made of five pure culture strains of alfalfa bacteria and five pure culture strains of red clover bacteria. The dates under which these cultures were obtained are noted in the report, one of the alfalfa strains being as old as 1912 and one as recent as 1932. In the case of the red clover strains, the oldest strain was isolated, a red clover nodule in Minnesota, in 1932, three other strains were isolated in 1934 and the fifth strain was in 1935.

In order to prepare the cultures for this study, a pure culture of each single strain was inoculated into 250 c.c. of yeast-mannitol liquid No. 79 on September 1, 1944. One week later, single strain humus cultures were prepared by mixing 40 c.c. of each liquid suspension of bacteria with 50 grams 200 mesh dried and partially sterilized humus plus the addition of 12.5 grams of finely ground limestone to neutralize the acidity.

Mixed cultures were prepared by mixing 20 c.c. of a single strain alfalfa liquid suspension plus 20 c.c. of
498 a composite liquid suspension of red clover bacteria with 50 grams of humus and 12.5 grams of limestone.

This composite liquid suspension of red clover bacteria was prepared by mixing together 50 c.c. of liquid from each of the five pure culture suspensions of red clover bacteria, making a total of 250 c.c. of this composite liquid.

The culture treatments used in this experiment were as follows:

No. 1 Single strain alfalfa No. 3DOa1.

Should I go to the trouble of reading all these?

499 Q. I would like you to identify the strains and the general results that were obtained by the effect of those strains on the plants.

A. Well, as I have mentioned, these strains were selected from different original sources and, according to the treatments, alfalfa was planted in one-half gallon pots, earthenware glazed pots, which were prepared as shown in Figure 1.

Q. Now, with reference to Figure 1, what do you have reference to in that statement?

A. Figure 1 on Page 2 of this report. A layer of coarse gravel was first added, the watering tube put in place, washed bank sand was added next and the sand was thoroughly moistened with Bryan's modified Crone's solution. Each pot was covered with wrapping paper tied and sterilized in the autoclave for five hours at 15 pounds pressure.

The alfalfa seeds were first freed of legume bacteria and a sufficient number inoculated with each culture treatment to plant five pots. Planting of the alfalfa was done on September 25. After planting a thin layer of fine gravel was put on top of the sand in each jar to reduce chances for contamination. Extreme care was exercised in watering; sterilized distilled water was added when needed and at 30-day intervals more sterilized Crone's solution was added.

500 The plants were photographed on January 9, 1945, and harvested on January 18, 1945. The roots were washed free of sand and the whole plants from each pot were dried, weighed, ground, and samples analyzed for total nitrogen by the standard Kjedahl method for total nitrogen determination.

I have attached, going with this report, a complete set of pictures which were obtained in the experiment.

Q. Doctor Erdman, I hand you herewith a set of pic-

tures and ask if you can identify them as the pictures you have just referred to. (Handing photographs to witness.)

A. These are the six pictures obtained in this experiment. They are the pictures.

Mr. Staley: If the Court please, I would like to have these photographs identified as Defendant's Exhibits 14 A to F, inclusive.

The Court: All right.

(Which photographs portraying above described experiment were marked, respectively, for identification, Defendant's Exhibits 14 A to 14 F, both inclusive.)

Mr. Staley: Q. Now, Doctor Erdman, will you please explain the general results of your tests, using the pictures and the data you have at hand?

501 A. Each picture is made from five pots inoculated with a single strain of alfalfa bacteria and below this, this same strain of bacteria plus a mixture of the five strains of red clover bacteria prepared in accordance to the article.

At the top of each picture is a set of controls of five pots and these controls are the same for all of the pictures.

The first picture represents alfalfa bacteria strain 3DOa1. The second picture is from the—

Q. Would you identify those by exhibit numbers, Doctor?

A. By number?

Q. Yes, by exhibit numbers.

A. Yes, I have those here. The first is Exhibit A. The second picture Exhibit B. From strain 3DOa7. I might add 3DOa1, there seems to be no apparent difference. I might also add in each one of these pots there are twenty plants. 3DOa1, the differences are not very marked. One might say a rather uniform set of pictures.

The Court: I don't understand what you mean by "control".

The Witness: The control is the series of pots to which no legume bacteria were added; that is the uninoculated pots. These plants were forced to get all of their nitrogen from the seed of the alfalfa plant. When that was associated—

502 The Court: Not inoculated.

The Witness: Not inoculated may have been a better term.

In the case of 3DOa7, there is an apparent stimulation where the clover bacteria were added in mixed culture with the alfalfa strain 3DOa7.

Exhibit C, Strain 3DOa10, no noticeable differences between the single strain and the mixture.

Exhibit D, Alfalfa Strain 3DOa12, very similar results, hardly any differences.

Exhibit E, one can notice no apparent differences.

Exhibit F, there is an apparent stimulation, possibly due to the mixture. It is due apparently to the mixture.

In order to make the study more complete, as I stated, the plants were harvested, dried and ground and subjected to nitrogen analyses.

504 Mr. Staley: Q. Doctor Erdman, what is your opinion with reference to the question of inhibition of one plant bacteriological specie when put in association with another?

A. I do not believe there is such inhibition among the legume bacteria, the different species.

Q. Upon what do you base your opinion?

A. I base that opinion upon very, or, practically no literature bearing directly on this particular subject except possibly this Bond patent.

Q. You agree with this statement in the Bond patent, as quoted from Page 2, Column 1, Line 74?

> " —it was generally believed that one species produced an inhibitory effect on another species within the same culture, whereby symbiotic nitrogen fixation by the plant and the organism was inhibited or even prevented."

A. I do not agree with that statement.

The Court: Did you have any opinion about that in 1938?

The Witness: If I was asked that question in 1938, I think I would have made the same statement.

505 Mr. Staley: Q. Doctor Erdman, what is your opinion with reference to a question of whether the various strains of legume bacteria remain constant in their effect upon the legumes over a period of years?

The Witness: A. It is well known that a strain of legume bacteria will maintain its efficiency over a period of years but to say that that strain will be constant and fix constant amounts of nitrogen when subjected to a given plant, is not true. In other words, they will vary from time to time.

Mr. Staley: Q. Have you ever run any test to determine that, whether or not they do vary from time to time?

A. Yes, we have in our laboratory run tests different years using the same strains on the same legumes.

Q. I hand you herewith copies of tests and ask if these are the tests you have been referring to. (Handing documents to witness.)

A. These are the tests that I had in mind from our laboratory.

The Court: And tests show that the strains do not remain constant?

The Witness: That is right.

506 The Court: And vary from time to time?

The Witness: Vary from time to time, different growing—

The Court: Doesn't that agree with both of the other experts?

Mr. Staley: Well, Mr. Bond has made a statement in his direct testimony that the strains remain constant and we are of the opinion—

The Court: Well, he didn't— As I remember, he said some of them had remained constant as long as twenty years but he didn't make a statement, as I remember it, that positively all of them remained constant for a long period of time.

Mr. Staley: Well, the inference was made that once a strain was obtained, that was their so-called alpha strain, that the efficiency of that strain remained relatively unchanged from time to time and, as he said, as long as twenty years.

Doctor Erdman has performed these tests over a period of years from time to time and we would like to submit this evidence on that basis.

The Court: All right. I may not have an accurate recollection of what Mr. Bond said.

Mr. Staley: If your Honor please, I would like to submit photostatic copies of the sheets of tests that have been identified by the witness and identify them as

507 Defendant's Exhibits 15-A to D, inclusive.

Mr. Staley: Q. Doctor Erdman, you have studied the Bond patent 2,200,532, have you not?

A. Yes, I have.

Q. Have you made any analysis and examination

508 of the tests and other data that is disclosed in the Bond patent 2,200,532?

A. I have studied it, yes.

Q. From these data, what is your opinion as to whether they establish a doctrine or precept of inhibition as a result of the mixing of the different species of the Rhizobium in a composite culture?

A. I do not think they establish that teaching, that doctrine.

Q. Why?

A. For one thing, I feel that there should be a much —in order to establish a point like that, there should be a much larger number of strains tested than he has given here.

Mr. Staley: That will be all, your Honor.

509 *Cross-examination by Mr. Thiess.*

Q. Dr. Erdman, as I understand, you have been with the Nitragin Company since 1928?

A. That is right.

Q. And was that the first contact you had in the production of cultures of this kind, commercially, for inoculation?

A. Commercially, yes.

Q. Prior to that time your work was more or less of an instructor and on fellowships doing—

A. Research work.

Q. —research work?

A. Yes.

Q. Now, you referred to this garden culture put out by the Nitragin Company. How do you pronounce that?

A. Nitragin.

Q. And I understood that you said that originally you put this culture on the market, that is, it was put on the market according to the can in the photographs that we have, for garden peas, garden beans, sweet peas, and 510 lupines. That is correct, is it?

A. That is correct.

Q. And thereafter, as I understand your testimony, you added to the strains?

A. Just one other strain.

Q. What other strain did you add?

A. The soy bean.

Q. And when did you add this other strain, the soy bean strain?

A. Oh, I believe just two years ago.
Q. That would be in 1943?
A. I think that is approximately correct.
Q. And did you say that you made tests on the individual strains of these cultures that are in this garden culture?
A. Yes, I did.
Q. And when you said you made tests on the individual strains, were those the strains that your company were using for single cultures?
A. That is right.
Q. And your company does put out single cultures for field work?
A. Yes, sir.
511 Q. And do you recommend these single cultures for field work?
A. We do.
Q. And do you recommend your garden culture for field work?
A. No.
Q. Why not?
A. Because it isn't sufficient to go over enough seeds to put on a field basis.
Q. Well, if you made the can large enough and put all these together, have you ever made any investigation to determine whether that would be satisfactory for field work?
A. It would be satisfactory for field work if there was a demand for it, yes.
Q. Well, I asked you, did you make any investigations or tests to determine whether it would?
A. No, I have not.
Q. Now, you referred to these tests that were applied to these single strains, and, as I understood, you referred to them as a vegetative test.
A. Vegetative, yes.
Q. By vegetative test you mean merely looking at
512 them?
A. I mean inoculating the strain on the legume and watching it grow.
Q. And you make your determination from merely looking at it?
A. Looking at it and examining it for nodules, yes.
Q. Now, as a man skilled in this art, would you wish to represent to this Court that that is a scientific way of

determining whether you are getting good nitrogen fixation in a plant?

A. No, I would not say so.

Q. Do you agree that in order to get good scientific results you would have to make a nitrogen chemical result?

A. Yes.

Q. I mean test, I should have said.

A. Yes.

Q. Now, referring to this can marked for identification as Exhibit 12. Where did that come from?

A. That came from our laboratory.

Q. From your laboratory?

A. Originally.

Q. Well, I mean when?

513 A. When?

Q. Did you produce this?

A. It was produced under my supervision when I was there during that year, yes.

Q. Well, what I have in mind, this particular can, did you get that out of the files or from the shelves of your company when you were asked to take part in this litigation?

A. No, sir.

Q. Well, where did it come from at that time?

A. I do not know.

Q. You don't know where this can came from?

A. No, sir.

Q. So under those circumstances you don't know where this can has been. How about the date on this can, where is that?

A. It is on the top label.

Q. On the top label. And that date, you say, was put on there when the can was put out?

A. That date is lithographed on the cover when we order our containers, and when we make the culture for that year it naturally is put on.

Q. So from that you conclude that this culture 514 was made prior to the date on the can?

A. Why, yes, prior to the date on the can.

Q. Now, who did you consult with when you were first brought into this litigation to make these tests, et cetera?

A. Mr. Elmers, of Agricultural Laboratories.

Q. Anybody else?

A. Yes, my superior of the company, Mr. L. D. Matchette.

Q. And who did you consult with as to the manner and type of tests that you were going to make?

A. That was discussed with Mr. Elmers.

Q. And did Mr. Elmers tell you to make tests merely on the alfalfa strains?

A. No.

Q. Your tests were made exclusively on the alfalfa strains to see whether there was inhibition on the alfalfa strains?

A. I made a test also on red clover.

Q. Have you produced that test here?

A. No, I have not.

Q. How many tests did you make on red clover?

A. I had almost an identical experiment set up on
515 red clover as reported for alfalfa.

Q. And did you run that test?

A. That test was run and completed, but unfortunately we had a little trouble with mildew on the strain of red clover that we used and a number of the plants were destroyed during the growing period. We did not, therefore, have a constant uniform stand in the pots and I concluded that the results would probably not be reliable on that count.

Q. So you did not follow the test through?

A. The test was followed through but I do not wish to lay any emphasis on the data.

Q. Now, these tests that were made that have been produced, that show the results that you got on the alfalfa, were made for this litigation?

A. Yes, they were made for this litigation.

Q. You knew that this litigation had been started and that these tests were going to be used in this litigation?

A. That is right.

Q. And you were cognizant long before that, were you
not, that Mr. Bond had contended that there was
516 inhibition and that it was the fact that he found non-
inhibitive strains, that that fact made it possible to make a mixed culture, were you not?

A. I was familiar with his patent when it came out, and of course that was in it, yes.

Q. Well, you were familiar also, were you not, or you knew of the fact that Mr. Bond had read a paper before a group at San Francisco, stating what he had discovered and invented and telling about this inhibition?

A. The report of that work doesn't bring out—I knew he gave a paper.

Q. That is all I am asking. You knew he gave that paper?

A. Yes.

Q. You had a representative there at that meeting, did you not?

A. Yes, we did.

Q. And you have never made any statement, either in the press or in the scientific journals of any kind, in which you denied that what Mr. Bond stated there was not correct, have you?

A. No.

517 Q. Now, on these photographs that you have presented I notice that—oh, you have a copy of them there?

A. Yes.

Q. —that the plants in the various series of pots are substantially uniform and there is no very wide deviation between the pots?

A. That is right.

Q. That is correct, is it not?

A. Yes.

Q. Now, you are, of course, conversant with the pictures of the tests that were run on clover by Mr. Curie, are you?

A. Yes, I am familiar with those.

Q. You have noticed the deviation in the growth of the various plants in those photographs?

A. Yes, sir.

Q. And do you, as an expert in the art, believe that where you have a deviation of the type that you have got there, that those tests run in that manner are scientifically properly conducted tests?

A. The fact that they are not uniform doesn't
518 disqualify them on the basis of a scientific test.

Q. Well, I mean, some of these photographs where you have this—for instance, one of the photographs that I referred to this morning. This photograph, for instance, it is Defendant's Exhibit 6-G, where you have a rather substantial growth in pot No. 4 in the upper series, and substantially the same growth in the pots in the lower series.

A. Yes.

Q. Now, if the growth in the pot No. 4 in the upper series was due to the introduction of nutrients from the outside, isn't it also possible that that was the very thing that caused that growth in the pots below?

A. Well, I would not say that that would be necessarily true.

Q. But it could be true, could it not?

A. It would be possible but not necessarily.

Q. Now, in conducting a test of this character, 519 would you consider it a good test in which you had control plants and you threw the control plants away at the end of the test?

A. Well, it all would depend on what you want to show from the test.

Q. Well, if you wanted to show the very thing that you wanted to show in your alfalfa tests, whether there was inhibition or not.

A. I can produce the data from my—

Q. Now, will you answer my question?

A. Would you repeat it?

Q. Would you consider it a good test if you threw away the control pots?

A. Ordinarily, no, it would not be.

Q. All right. Now, can you tell me how long the different strains used in your tests, bacteria strains, had been associated together in the mixed culture at the time the culture was applied to the seed?

A. Are you referring to this experiment?

Q. The experiment you made, yes.

A. Nineteen days.

Q. Nineteen days?

520 A. In the humus, in association with the strains from the different groups.

Q. The two—

A. The alfalfa and clover.

Q. —had been together in the humus for nineteen days, is that correct?

A. I think it is nineteen days. Seventeen days, to be exact.

Q. Now, what method of statistic analysis did you employ in your tests reported in Defendant's Exhibit 13?

A. I applied an analysis of variance.

Q. And an analysis of variance is one of the real accepted tests for that purpose, is it not?

A. It is.

Q. Now, with respect to this consistency of strains, the characteristics of the strains, you will agree, will you not, that there are strains that have been consistently 521 used for twenty to possibly even thirty years, is that correct?

A. That is right.

Q. And if these strains varied widely there would not be much object in making these cultures, would there, because you would never know what you would get?

A. You have to continually be testing them all the time.

Q. You have to test them all the time?

A. Yes.

Q. What do you mean by that? Will you tell me how often?

A. Well, we will test as many as we can each year, every year.

Q. All right, you test them every year and you find that most of them carry through and keep constant characteristics, do you not?

A. That is true, but they don't always—the first high strain one year will not necessarily be a high strain the next year.

Q. There may be some exceptions, but as a rule they run pretty much alike, do they not, the good strains?

522 A. The good strains will maintain themselves pretty well over a period of years.

Q. And in this art the manufacturers of these cultures do use good strains, do they not?

A. I hope they do, yes, sir.

Q. And if these strains did not maintain these constant characteristics, you would have to test them oftener than once each year, would you not?

A. Well, I would not say any more often than once a year, no, that ought to be sufficient.

Q. Well, that would indicate that you are pretty well satisfied that the strain holds its own for a year's time or you would test them oftener, would you not?

A. That is true, and another reason for testing is the fact that they may become contaminated during the carrying them over in the laboratory.

Q. I appreciate that that is another reason that you test them.

A. Sure, to make sure that we have pure cultures to deal with at all times.

Q. In other words, you always have that problem,

523 they have got to be kept—

A. Pure.

Q. —pure, and there is a possibility that something in the air might contaminate them?

A. That is right.

Q. Now, had you prior to August, 1938, made any search of the scientific literature to determine what information was given as to the effect that mixing different species of Rhizobium would have on the nitrogen fixing ability of every species?

A. No, I did not.

Q. You have never made any such investigation, have you?

A. I haven't been particularly interested in the problem.

The Court: Q. Does your company produce a combination?

A. Just the garden size.

Q. I meant for clover and alfalfa?

A. No, sir.

Q. Just the garden.

524 A. Yes, sir.

Mr. Thiess: Q. Now, did you prior to August, 1938, conduct any efficiency tests to determine the nitrogen fixing ability of any species of Rhizobium on its host plant when mixed with other species, as compared to the nitrogen fixing ability of the same species when used alone on its host plant?

A. No.

Q. Then when you stated that in 1938 you did not believe that there was anything in the literature to show that there might be inhibition, what did you base that opinion on?

A. Didn't you ask me if I made tests?

Q. Prior to 1938. That was my previous question and you said no.

A. I don't see the relation to your second question.

Q. Well, you told the Court that you would give that opinion as of 1938, do you remember that?

A. Yes.

Q. Well, now, if you had not made any tests and you had not made any search of the literature, on what did you base that opinion?

525 A. Well, I would base it personally on the fact that we have been putting up this mixed culture for garden size for a period of years, with very fine results.

Q. But, as I understand it, that garden culture was used merely for garden purposes. You sold the single culture for field purposes, that is correct, isn't it?

A. That is right, yes.

Q. And does your company—

The Court: The statement, I think, that the Doctor answered me on was this one contained on page 2, in the first column, beginning with line 74 of the patent, where it says:

> "It was generally believed that one species produced an inhibitory effect on another species within the same culture, whereby symbiotic nitrogen fixation by the plant and the organism was inhibited or even prevented."

Now he says he didn't agree with that.

Mr. Thiess: That is right.

526 The Court: And his answer would be the same in 1938. He did not agree with the statement that it was generally believed or generally accepted in the profession, is what I understand his statement to be.

Mr. Thiess: Yes.

The Court: Now, am I to understand that that is merely your opinion as to the question, rather than an opinion as to what the persons familiar with the art believe about it?

The Witness: Well, I would say it is my own opinion and persons familiar with the art also.

The Court: But I thought I understood you to answer the question a few minutes ago that you had not investigated the literature on the art at that time.

Mr. Thiess: That is correct.

The Witness: Well, if I made that statement I would like to withdraw it, because I have investigated the literature. In fact, I have read this book from beginning to end.

Mr. Thiess: Q. What book are you referring to?

527 A. This Root Nodule Bacteria and Leguminous Plants, by Fred, Baldwin, and McCoy; as well as many other pieces of literature.

The Court: Well, I expect I must have misunderstood you then, because you would hardly have made the statement I thought you made. I misunderstood you.

Mr. Thiess: You did not misunderstand him.

The Witness: I misunderstood the question if I answered that way.

The Court: I don't want to—

Mr. Thiess: Q. Now, you referred to this book. Do you understand that that book makes that sort of a statement?

A. That book?

Q. Yes.

A. In one instance it makes a statement that they are not antagonistic.

528 Q. Where do you find that in the book? Is that the statement you are referring to (indicating in book)?

A. That is it.

Q. Did you ever read the Alicante article on which that statement is based?

A. No.

Q. (By Mr. Thiess) Now, have you any other articles?

A. That show what?

Q. That show that there is no inhibition?

A. I know of no articles that give definite proof of inhibition.

Q. But a while ago you said you read that book
529 and other articles. Now, have you got any article that gives proof that there is not inhibition?

A. That there is not inhibition?

Q. Yes.

A. I couldn't cite any right now.

Q. On this cover, Doctor, we find the name over the NITRAGIN, which is your trade name for the product: Nobbe-Hiltner Process.

A. Yes, sir.

Q. Is the Hiltner there referred to the Hiltner that Mr. Bond was referring to the other day?

A. I would have to check on that to make sure. I wouldn't know exactly.

Q. You don't know what this Nobbe-Hiltner process is?

A. I know what that process is. Way back in 1896 when it came on the market it was just a process for growing these organisms and distributing them to the trade in commercial channels.

Q. Do you know whether the man of that process is this L. Hiltner?

A. I wouldn't be able to state definitely unless I had the original reference to the Nobbe-Hiltner that put out this original culture. I couldn't state definitely.

530 Q. Now you say you are thoroughly familiar with the Bible?

A. I couldn't recite it verbatim.

Q. I appreciate that, but referring to this book on Root Nodule Bacteria in Leguminous Plants, pages 294 and 295, there are, I would say, at least 12 or 14 refer-

ences to this man Hiltner. Would you say that that is the same man?

A. I suspect it is the same man, especially now since I see he has some articles dated 1887. However, I still wouldn't be able to prove it.

Mr. Thiess: That is all, Doctor.

Redirect Examination by Mr. Staley.

Q. Doctor Erdman, the tests that were made by Mr. Curie, or the photographs that were submitted during the testimony, that were made by Mr. Curie and were referred to you in the cross-examination by counsel for the plaintiff, and I would like to ask your opinion
531 as to whether the tests which have been referred to here and have been considered during the testimony are sufficient to determine the question of whether inhibition or non-inhibition exist even if there were no control pots used?

A. I would say that the data would be sufficient without the controls.

The Court: You are speaking of the tests made by Mr. Curie?

The Witness: Yes, sir, to determine inhibition among these legume bacteria.

The Court: Were his tests any more extensive than those made by the patentee here, as disclosed in the patent?

The Witness: I would say so, yes, sir.

Re-cross Examination by Mr. Thiess.

Q. Would you say that that would be true, the answer that you just gave on redirect, if the control pots were badly contaminated?

A. If the control pots were badly contaminated it would be a question of what— When you have a contaminated control you cannot tell from where they came and it might be misleading to make that interpretation.

532 Mr. Thiess: That is all.

(Witness excused).

Mr. Greer: I think we might at this time take up the offer of all of the exhibits on behalf of the defendant from

1 to 15-A, B, C and D. That includes the series numbers 11-A to B, 14-A to S, and 15-A, B and C, all that have been marked for identification.

The Court: Is there any objection to any of those?

Mr. Thiess: Oh, yes, there are.

Mr. Neuman: If your Honor please, we reserve the right to object to Number 5, 6-A to L, and 7, because we have not completed our cross-examination of Mr. Curie.

The Court: All right.

535 The Court: Then the exhibits will be received in evidence from 1 to 15, inclusive, with the exception of 5, 6 and 7.

(The chart entitled: CULTURE CHART AND 1932 PRICE LIST was received in evidence as Defendant's Exhibit 1.)

(The package entitled "INOCULATION", "McQUEEN'S INOCULATOR", "GOOD FOR SWEET PEAS—LUPINES, GARDEN PEAS AND BEANS", was received in evidence as Defendant's Exhibit 2.)

(The photographs portraying the front and back side of package, Defendant's Exhibit 2, were received in evidence as Defendant's Exhibit 3.)

(The photostatic copy of sheet of advertisement and the photostatic copy of WHOLESALE PRICE LIST, effective July 16, 1937—Season 1937-38, of McQueen's Inc., Baltic, Ohio, in re McQueen's Seed Inoculants,
536 etc., were received in evidence as Defendant's Exhibit 4.)

(The document entitled: BOND PATENT No. 2,200,532: NITROGEN FIXED PER 10 PLANTS CLOVER, etc. was received in evidence as Defendant's Exhibit 8.)

(The carbon copy of letter dated June 30, 1941, addressed to Dr. H. W. Bachelor, Ohio Agriculture Experiment Station, Wooster, Ohio, from I. H. Curie, was received in evidence as Defendant's Exhibit No. 9.)

(The photostatic copy of advertisement headed "NITRAGIN FACTS THAT BEAR GREAT WEIGHT", dated 1923, showing prices of The Nitragin Company, Inc., of Milwaukee, Wisconsin, and giving miscellaneous cuts, price cuts and other information was received in evidence as Defendant's Exhibit 10.)

(The photographs of the can showing the words:
537 "NOBBE-HILTNER PROCESS, NITRAGIN FOR GARDEN PEAS; GARDEN BEANS; SWEET PEAS AND LUPINES, GOOD UNTIL

DECEMBER 31, 1935" (Defendant's Exhibit 11-A for identification); and showing the words: "THE ORIGINAL LEGUME INOCULATOR" "NITRAGIN", etc. (Defendant's Exhibit 11-B for identification); and showing the word DIRECTIONS (picture of side of can sample)—USE ONLY FOR SEEDS STATED ON TOP LABEL, etc. (Defendant's Exhibit 11-C for identification); and showing the word: "CAUTION", etc. and the word: "GUARANTEE", etc. (Defendant's Exhibit 11-D for identification) were received in evidence as Defendant's Exhibits 11-A to -D, inclusive.)

(The can labeled "NITRAGIN" of The Nitragin Company, Inc., Milwaukee, Wis. was received in evidence as Defendant's Exhibit 12.)

(The report of Lewis W. Erdman headed "DOES ONE
538 SPECIES OF LEGUME BACTERIA PRODUCE AN INHIBITORY EFFECT ON ANOTHER SPECIES WITHIN THE SAME CULTURE?" was received in evidence as Defendant's Exhibit 13.)

(The six photographs, each containing pictures of three rows of jars with five jars in each row, the top row entitled: "ALFALFA" and "CONTROLS"; the middle row of jars containing the label: ALFALFA BACTERIA STRAIN 3DOa1, ALFALFA BACTERIA STRAIN 3DOa7, ALFALFA BACTERIA STRAIN 3 DOa10, ALFALFA BACTERIA STRAIN 3 DOa12, ALFALFA BACTERIA STRAIN 3 DOa15 and 5 STRAINS ALFALFA BACTERIA, on the photographs labelled 14-A, -B, -C, -D, -E and -F, respectively; and the bottom row containing the label entitled ALFALFA BACTERIA STRAIN 3DOa1 PLUS 5 STRAINS RED CLOVER BACTERIA, on Exhibit 14-A and same title but with numbers 3DOa7, 3DOa10, 3DOa12, 3DOa15 on Exhibits 14-B, -C, -D, and -E respectively, and the bot-
539 tom row label on Defendant's Exhibit 14-F of 5 STRAINS ALFALFA BACTERIA PLUS 5 STRAINS RED CLOVER BACTERIA, was received in evidence as Defendant's Exhibit 14-A to 14-F, inclusive.)

(The photostatic copies of sheets of tests marked Defendant's Exhibit 15-A to 15-D, inclusive for identification and being each of two sheets, and entitled as follows: EXPERIMENT NO. 1—CRIMSON CLOVER, Sept. 22 to January 7, 1938 and CRIMSON Clover—Trifolium incarnatum, Oct. 19, 1939 to Jan. 20, 1940, being the two pages of Defendant's Exhibit. 15-A; entitled: RED CLOVER—Trifolium pratense, Oct. 18,

1939 to Jan. 15, 1940 and EXPERIMENT No. 1—RED CLOVER, Sept. 21 to Dec. 14, 1937, being the two pages of Defendant's Exhibit 15-B; and entitled: TABLE 3: NITROGEN FIXATION BY TWENTY STRAINS OF R. MELILOTI ON ALFALFA, BURR CLOVER AND SWEET CLOVER, Oct. 15 to Dec. 10, 1938, and TABLE 3 (continued) being the two pages of Defendant's Exhibit 15-C; and entitled: TABLE 5: NITROGEN FIXATION BY
540 TWENTY STRAINS OF R. MELILOTI ON ALFALFA BURR CLOVER AND FENUGREEK, Feb. 10 to April 17, 1939 and TABLE 5 (continued), being the two pages of Defendant's Exhibit 15-D, were received in evidence as Defendant's Exhibit 15-A to 15-D, inclusive.)

541 DR. THOMAS FRANKLIN MANNS a witness called on behalf of the defendant, being first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Greer.

Q. Will you please state your full name, age, residence, and present occupation?

A. Thomas Franklin Manns; age 69; occupation, plant pathologist and soil bacteriologist, University of Delaware, Newark, Delaware.

Q. And where is your residence, Doctor?

A. Newark, Delaware.

Q. Will you please state just briefly to the court, Doctor, and don't be afraid to talk out loud,—I think everybody in this courtroom with the exception of myself, wants to whisper about something.

Mr. Thiess: I take exception to that.

Q. (Continued by Mr. Greer) Will you please state what your training, education and experience has been along this line of plant pathology and soil bacteriology?

A. I took my undergraduate work at North Dakota State College in 1896-1901; I took my Master's degree there in 1901 to 1903 in the field of soil microbiology,
542 diseases of flax carrying over in the soil.

I have been in the field of plant pathology and microbiology since 1907. Three years I was in the Philippines, from 1904 to 1907 as Provincial High School Superintendent in Science, teaching science and agriculture.

In 1907 I went as assistant to the Experiment Station, Wooster, Ohio, and was there as assistant botanist from 1907 to 1911.

In 1911 I was placed as head of the Department of Soil Bacteriology, which position I held for one year.

In 1912 to the present I have been head of the Department of Plant Pathology and Soil Bacteriology at the University of Delaware.

Q. Well, Doctor, can you tell us, in light of that experience throughout these years since your graduation from college, have you kept up or do you feel that you have kept up with the literature that has been published in this and other countries in connection with plant pathology and bacteriology, in connection with soils and leguminous plants, particularly?

A. I am teaching both sciences in the University and have research work in both sciences at the Experiment Station in Newark, Delaware. I feel that I have kept
543 very well up in the literature and science.

Q. Now, have you had any experience with letters patent of the United States, obtaining the same, and experience in connection with them?

A. I have taken out several patents.

Q. You acted as your own attorney in them, have you not?

A. I have, sir, yes.

Q. Now, have you made any particular study of the Bond patent in suit in this action, 2,200,532?

A. I have gone over the Bond patent very carefully.

Q. Well, I first want to invite your attention to the paragraph that was in discussion a few minutes ago, on page 2 of that patent. Have you got a copy of it before you?

A. I am afraid that I have left my copy down at my desk there and I will be very glad to get it or someone may bring it up, the one that has notes on it. There are two copies there.

Q. I want to invite your attention to the last two lines in the first column on page 2, with the understanding that the statement contained therein was made on August 24, 1938, and that statement reads that at that time
"it was generally believed that one species", that is,
544 a species of the genus Rhizobium bacteria "produced an inhibitory effect on another species within the same culture whereby symbiotic nitrogen fixation by

the plant and the organism was inhibited or even prevented".

Would you say that was an accurate or correct statement of the opinion that was held among scientists and those skilled in this art at that time?

A. I would say it is not.

Q. Well, have you, since then, Doctor, made any study at all in this art or read any articles or had referred to you any investigations that would lead you to believe differently now?

In other words, what is your opinion now as to whether or not there is this state of inhibition or lack of inhibition in this establishment of the so-called symbiotic relationship between Rhizobium bacteria and its host plant?

A. I have seen no evidence of it in my researches.

Q. Well now, have you made an analysis of the tests and the data appearing in this Bond patent, 2,200,532, in which he undertakes to support the theory of inhibition? Have you made an analysis and examination of the tests and data as shown there?

A. I have gone over the data very carefully and
545 I do not consider it establishes the fact that he has stated.

Q. Why do you say that, Doctor? What brings you to that conclusion or way of thinking?

A. Because there, first, is too great a variation in the data and the data is too scanty. The standard deviation in 5 is so great that the deviation doubled, that is, the amount of variation above and below the average, his lowest plot is less than the deviation, which is a very strong deviation where only this amount of data is presented.

Q. Well, now, Doctor, as a matter of fact there is a lot about these bacteria that even Mr. Bond and other scientists don't know, isn't there?

A. Very true.

Q. There is this symbiotic relationship whereby, in some instances, nitrogen fixation results when the bacteria is brought into association with the roots of a leguminous plant.

Just exactly what brings about that nitrogen fixation is a law of God or Nature that man doesn't know, isn't it?

546 A. We do not know what the actual facts are in causing the fixation. We have our theories, of course.

Q. (By Mr. Greer) Well, what would you say, Doctor, as to the same species of bacteria brought into association with the same species of leguminous plant under similar circumstances at the same time?

Would you or would you not necessarily obtain the same nitrogen fixation in those two instances?

A. In the best control that we have in laboratory technique we vary considerably.

Q. Do you know why that variation is occasioned?

A. We do not.

Q. Now, coming back to this question of literature, Doctor: I want to invite your attention to some articles which Mr. Bond, when on the witness stand, brought to the attention of the court, as I understand it, in support of his thesis that there is this condition of inhibition in connection with this bacteria and the host plant.

And the first article was by a German named Max
547 Kronberger, I believe it, if I pronounce it correctly; you understand the article that I mean.

A. Kronberger.

Q. Have you got a copy of the translation of that article, Doctor?

A. I have not the copy with me.

Q. How?

A. I have not the copy with me.

Q. I will hand you a copy of it (handing document to the witness). You have studied that carefully, have you,—gone over it?

A. I have, very carefully.

Q. What would be your statement after a careful study of that article as to whether or not it supports or does not support a thesis of inhibition in a plurality of strains of this genus Rhizobium?

A. I do not think that the article supports that.

Q. Now, will you tell us why you think that, Doctor?

A. Because the technique is not standard.

Q. The technique is not what?

A. Standard, general usage.

Q. Where does it violate any standard rules?

A. In the first place his period of sterilization of
548 the soil is too short.

The Court: Well, when you say his article doesn't support that theory, you mean that it doesn't effectively support it, don't you? It advances that theory all right, doesn't it?

The Witness: It advances the theory but the technique as we—

The Court: But the technique that he uses doesn't lend weight to it.

The Witness: Is not the standard technique to prove the facts he states.

Q. (By Mr. Greer) What do you mean by this period of sterilization he spoke of?

A. He speaks of sterilizing soil, a large quantity of soil for a period of 25 minutes at one atmospheric pressure, 15 pounds. Everyone who has worked in the field of soil bacteriology knows that that length of period,—the heat, the steam would not penetrate that soil to the depth necessary to make it sterile.

Q. What would be the effect of contaminating bacteria in the soil if it had not effective sterilization?

549 A. There may be nodule organisms of other types there, particularly other types that might influence the experiment considerably.

Q. What is the generally accepted, or do you know what is the generally accepted standard in this country of a period of sterilization and the temperature or pressure under which that sterilization is brought about?

A. The amount of soil that he uses, in my class room we have found it takes four hours to sterilize that amount of soil.

Q. Against the 25 minutes that he took?

A. Against the 25 minutes. Waksman tells us that it may be done in two hours but he doesn't tell us the amount of soil.

Q. Are there any other criticisms that you have to offer with regard to that article as being defective in its demonstration?

A. The type of soil that he uses is not standard in our technique for studying nodule organisms and their influence one upon another.

He uses 2600 grams of sand and 1000 grams of humus, with certain additions to it.

Q. Well, what about his method of sterilizing the seed?

550 A. He uses in the sterilization of the seed a chemical ten times as strong as we would recommend in our practice; that is, he uses a 1% corrosive sublimate where we would stay by 1/10th of 1% or we would prefer other methods.

Q. What would be the effect of using the strong solution that Kronberger used?

A. The strong solution that he uses would injure the seed, particularly the smaller seeds.

Q. By the way, Doctor, along this point of inoculating seed or soil, is there any difference in the functioning of the bacteria and the matter of inoculating the plant, whether you inoculate the soil that the seed is planted in or inoculate the seed before they are put in the soil?

A. Very little difference in our experiences.

Q. Both are standard, recognized practices, are they?

A. Both are. In the early days practically all of the inoculation was by soil.

Q. Well now, Doctor, I will ask you if you did any particular research work in connection with this symbiotic relationship of bacteria to leguminous plants? If so, when and under what circumstances?

A. I have been working with that problem for—you might say ever since I have been at the Delaware
551 Experiment Station, but during the years 1914, 1915 and 1916 we did some experimental work on humus as a carrier of beneficial bacteria.

Q. Well now, will you explain how you happened to do that particular work with humus as a carrier for bacteria?

A. We were working with commercial cultures of inoculants and found on the market many that were inferior and we believed that part of the trouble was the base that was used for carrying these inoculants.

Q. That what?

A. The base that was used—

Q. When you say "we" who are you referring to when you say "we"?

A. I mean several in my department who were working with me. The soil bacteriological work I refer to, and those who had been working with me have talked over these points.

Q. Now, was there any official report made of your research in work done in that connection?

A. Bulletin 115 from the Delaware Experiment Station,—Delaware College and Experiment Station, reports that work.

Q. And when was that published?

A. That was published in 1916.

552 Q. Published by the Delaware College of Agriculture, as I understand it?

A. I beg your pardon.

Q. It was published by the Delaware College of Agriculture?

A. Delaware College Agricultural Experiment Station.

Q. And what was done with it, in the matter of distribution?

A. It was generally distributed on the mailing list which goes to all the land-grant colleges and research institutions; also to the mailing list of the farmers of the state.

Q. Who prepared that report, Doctor?

A. I prepared that report.

Q. Is that a copy of the report as it was published in December, 1916 (handing paper to witness)?

A. That is a copy of the report as published in 1916.

Mr. Greer: The defendant offers in evidence this paper, published in 1916, and identified by the witness, as Defendant's Exhibit 16.

The Court: That was your report in the experiment on humus?

The Witness: Humus as a carrier of fertilizer and
553 beneficial bacteria.

The Court: It may be received.

(Said document entitled: BULLETIN No. 115, DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION: "A PRELIMINARY REPORT ON MUCK HUMUS AS A FERTILIZER AND CARRIER OF BENEFICIAL SOIL BACTERIA" by Thomas F. Manns and Joseph M. Goheen, dated December, 1916 was marked Defendant's Exhibit 16 and received in evidence.)

Q. (By Mr. Greer) Now, Doctor, can you tell us whether or not that report deals at all with the matter of an artificial inoculant as to the bacteria that are specific to leguminous plants?

A. It does.

Q. Will you point out to us anywhere without going thru all of your report, Doctor,—will you point out to us specifically any portion that has to do with the matter of an inoculant—

A. Well, on page 25, second paragraph: "It has
554 been inferred by certain producers of commercial inoculants that the organism of each particular legume requires a culture medium slightly different from that of another and particularly adapted for the organism in question. Further, that the germs for one variety of legume will not work on any other variety of legume. In the light of recent investigations the present work shows that the organisms for the different groups of important agricultural legumes may be successfully carried in one and the same compost."

Q. What sort of an inoculant did you use in your experiments that you conducted that are mentioned in this report?

A. We used a humus in which the several legume organisms were put in in pure culture.

Q. It was then what we have been referring to, was it, as a composite culture?

A. It is a composite culture.

Q. Will you state whether or not there were a plurality of strains of the bacteria that were supposed to be specific to more than one cross-inoculation group of leguminous plants?

A. It was a composite of several of the cross-inoculation groups of Rhizobium of the legumes.

555 Q. Now, do you make any particular reference to that other than what you have just read in this report? If so, will you call our attention to the specific parts of your pamphlet showing that?

A. In this bulletin we have used sterilized sand for carrying on inoculation work with such a composite culture, using that sand according to standard practice and in that work we have shown that when the several groups, the alfalfa group, the clover group, the vetch, the cow peas, and the soybeans were used, we were able to carry these several groups in one and the same compost and produce different splendid inoculation.

"The splendid inoculation—"

The Court: What page?

The Witness: Page 27, the lower paragraph.

A. (continued) "The splendid inoculation produced in these sand cultures would indicate that such humus as was used in these experiments could be readily inoculated and composted so as to carry all the important organisms

for the inoculation of the different groups of important agricultural legumes."

Q. (By Mr. Greer) Now do I understand from that when you say the different groups,—the organisms for the inoculation of the different groups of important
556 agricultural legumes, that in this single inoculant you had the organisms, that means, does it, the bacteria?

A. That is correct, of the particular cross-inoculation group.

557 Mr. Greer: Q. And that bacteria was of the kind that was specific to these groups of plants consisting of alfalfa, clover, vetch, cow peas and soy beans?

A. Right.

Q. How many cross-inoculation groups do they embrace?

A. They represent five inocular groups.

Q. But, do you mean, Mr. Manns, that you put the inoculant from all of the different plants in the same humus at the same time?

A. At the same time. These were all grown separately as pure cultures and incorporated in the one humus as a composite inoculant.

Q. And then that was used to inoculate those five
558 different ones?

A. To inoculate those five different sand pots that were planted with five different legumes.

Mr. Greer: Q. Will you explain that a little further? What was put in each pot?

A. In each pot was planted a different group of legumes, clover in one, alfalfa in another, soy beans in another, cow peas in another and vetch in another.

Q. Is that shown anywhere in this report?

A. That is shown in figure VII, I believe.

Q. I call your attention to figure VII.

The Witness: (Continuing:) Illustrated in figure VII.

Mr. Greer: Q. Is it figure VII or Plate VII?

A. I mean in Plate VII, at the end of the booklet.

Mr. Greer: Q. Now, will you turn to that page, where Plate VII appears, and explain to His Honor what is shown there?

A. In the first series of pots—I think I have made it plain that these pots were sterilized for four hours,
559 at fifteen pounds pressure.

Mr. Greer: Q. Just what is shown in those pots? There are three series of pots there.

A. There are three series of pots here in which the amount of inoculant was varied, and we have based the variation on agar culture practice, as we say. There are 2,000,000 pounds in the furrow slice of an acre. That is the generally accepted statement of the 6-inch acre, 2,000,000 pounds. This varies slightly with the type of soil. If it is a clay soil, it is a trifle less. If it is a heavy soil—I mean if it is a sandy soil, it would be a trifle more. But usually there is no surplus. We put it on a 6-inch acre, and here we have used the inoculation on that 8 pounds of sand which is in the 7-inch pot; there is 8 pounds of sand. We have used 2 pounds of the compost at a 2,000,000 pound acre, or in actual figures there is .004 of one gram used in the first series of each of the pots, .004 of one gram—

Mr. Greer: I do not think it is necessary to go into that detail, Doctor.

The Witness: In the second series is the 100 pounds
560 at the 2,000,000 pound rate and in the third series 500 pounds at 2,000,000 rate.

Q. Will you tell us what was the result of the test that you had there in connection with the fixing of the nitrogen in the growth of the plant?

A. The result of the test in connection with the fixation throughout was splendid inoculation, as given on page 27, at the bottom of the page.

Mr. Greer: The defendant calls particular attention of counsel for the plaintiff that we are relying, of course, on all of this pamphlet, but we will have particular reference, in order to save time in looking through every page of it, to page 20 with regard to compost No. 25, page 22, compost No. 28 and compost No. 30, showing what the compost consisted of; this page 25—

The Witness: Compost 25.

Mr. Greer: (Continuing:)—and page 27 and page 40—well, page 39, paragraph 9, on page 39, page 40, with reference to Plate VII and the illustration of Plate VII; all of those will be particularly referred to.

Q. Now, Doctor, will you tell us how you prepared the inoculant which you used in these tests?

561 A. The inoculant which was used in these tests was prepared by getting pure cultures of each of the strains in which we were working on soy beans, cow peas, crimson clover and alfalfa. Pure strains of those were inoculated into a humus soil:

Q. Where did you obtain those strains?

A. Those strains were obtained in the sandy lands of lower Delaware, where we usually go for cultures of legumes to show efficiency. If they show high efficiency in those sandy lands, which are low in nitrogen, and the crop responds well, we consider that the inoculant must be good.

Q. Who isolated those?

A. I isolated those myself.

Q. And then after isolating the strains, what did you do with them?

A. Cultured them for propagation to be placed into a humus for inoculant.

Q. Was that culture a separate group or a composite group?

A. A composite culture of these four groups.

Q. Then what did you do after you had cultured them?

A. I inoculated the compost as stated in that 562 mixture there.

Mr. Greer: Your Honor understands what the word compost means?

The Court: It is just another word for the base?

Mr. Greer: That is the carrying medium, really is what it is.

Q. How was that compost inoculated?

A. How was it inoculated?

Q. Yes.

A. We used, in this particular compost, 2,000 pounds of culture, the raw material from the Alphano beds and with several other inoculants, plus the 25,000 pounds of inoculant.

Q. What if anything did you do with regard to the single strain prior to inoculating the compost?

A. I tested these several strains to see what they had.

Q. What was the purpose of that test?

A. Simply to see that they had the proper efficiency, as we would test every strain before using it.

Q. All right. Then, I believe you had gotten along to putting the inoculant in the compost. Then what did you do next?

A. We planted this, a 4-gallon pot containing 8 563 grams of this particular compost, and planted it with these several legumes that are mentioned here.

Q. And after the legumes grew, what did you do then?

A. At the end of the period that is given here, they

were planted on January 14th, 1916. They were removed from the pots on March 30, 1916, a little short of three months in there.

Q. Then what did you do with them when you removed them from the pots?

A. During the time of growth, we took notes as to how the legumes were appearing, whether they were healthy or not, and at the time of the expiration, we took the plants right out of the soil and examined them, for inoculation.

Q. How did you examine them, Doctor, for inoculation —I mean for nodulation?

A. We pushed the soil away from the roots and examined them visually.

Q. Visually?

A. Yes. The notes state that, under "Cow peas" "abundant, very large"; Soy beans, "good, large"; Crimson clover, "medium, small," nodules; and Alfalfa, "abundant, very large."

564 Q. Does that have any reference or not to nitrogen fixation?

A. It may have reference to it or may not, that is, if the particular soil is heavy, carrying plenty of nutrients for the plant, it may mean that there was very little fixation of nitrogen. If it was rooted in a sand series, it would mean, if your plant were showing very nice and green, that there was a heavy fixation of nitrogen.

Q. From your experience in this line, Doctor, can you tell from a visual examination, including the color of the plant and the general growth and development of the plant, anything at all as to whether or not there has been nitrogen fixation?

A. We can tell whether the plant has abundance of nitrogen in it, and if it is on light sandy land, we would draw the conclusion that the nitrogen is coming from nodule formation.

Q. Can one skilled in the art tell with any degree of accuracy as to that?

A. Yes. Anyone skilled in the art can tell with very great accuracy.

Q. Simply from the observation?

A. Yes, simply from the inspection.

565 Q. Now, can you tell us whether or not you made any comparison between the plants which were grown

in this compost, with a composite culture and the efficiency test as to the single culture which you stated you had made?

A. The single cultures were made in sand along with the sand series and in the sand the single cultures showed just about equal to and I could tell no difference so far as the eye could discern, between the single culture and the composite culture.

Q. Did you or did you not make that comparison?

A. I did make that test.

Q. After you had completed this work, Doctor, what did you do then with this inoculant? As I understood you, that inoculant was one you got up yourself, is that true?

A. That is true.

Q. Well, what did you do with it after that?

A. The work was being done under Fellowship with the Alphano Humus Company, and the Alphano Humus Company it once adopted the technique that we had shown for the production of a composite culture.

Q. Do you know what business the Alphano Humus Company was in?

566 A. The Alphano Humus Company was in the commercial game of selling humus from the deposit at Summit, New Jersey, where they had some 3,000 acres.

Q. Do you know whether or not they placed upon the market composite inoculant?

A. They did.

Q. And can you tell us when that was?

A. It was shortly after these experiments were conducted and was running as far as I can recall up to '23 or '4.

Q. By these experiments you refer in using that expression to the experiments in the bulletin?

A. Yes, sir.

Q. (Continuing:) Defendant's Exhibit Number 16, Bulletin No. 115?

A. That is right.

569 (And thereupon at about the hour of 5:20 o'clock P.M., on Wednesday, June 27th, 1945, an adjournment was taken until the following day, Thursday, June 28th, 1945, at the hour of 9:00 o'clock A.M.)

572 Q. Doctor Manns, I will hand you a document and ask you if you can state what that is (handing document to witness)?

A. This is a pamphlet put out by the Alphano Humus

Company describing their humus and its value as an inoculant and carrier of beneficial bacteria.

Q. Have you ever seen pamphlets similar to this pamphlet?

A. I have seen similar pamphlets.

573 Mr. Greer: Then we offer that publication as Defendant's Exhibit Number 17.

The portions of it that we particularly rely upon are pages 20, 21 and 23.

The Court: Any objection, Mr. Rathburn?

Mr. Rathburn: Yes, Your Honor, we object to the offer to this extent: We don't object to it as a publication, but it is an advertising booklet. We object to it so far as it proves any statements that are made about the use and sale. This public use by the Alphano Inoculant Company is not pleaded. The booklets are just pleaded as publications.

The Court: That is the sole purpose of this offer?

Mr. Greer: That is the sole purpose, to show that there was in 1916 a publication of the use of Alphano inoculant as a composite humus.

574 The Court: When was it published? I don't see any date.

The Witness: It was published following the research work upon Alphano humus.

The Court: What year?

The Witness: From 1916 to 1923.

575 The Court: It may be received in evidence for the limited purpose for which it is offered.

Mr. Greer: It is not offered for any other purpose than that of publication.

(Said booklet entitled "The Alphano Book", published by the Alphano Humus Company, Whitehall Building, 17 Battery Place, New York City, so offered, was received in evidence by the Court, and marked Defendant's Exhibit 17.)

Mr. Greer: Q. Now, Doctor, do you have a sample of the original humus you were working with in your 576 experiments in connection with this Alphano product?

A. I do have the original humus that were used in these composites.

Q. At what time?

A. During the research work from 1915 to the date of publication of Bulletin 115.

Q. And that is the same publication?

A. Bulletin 115, Delaware College Agricultural Experiment Station, December 1916.

Mr. Greer: Now, the defendant offers in evidence as Defendant's Exhibit 18 the sample just referred to by the witness.

The Court: It may be received.

Mr. Thiess: What was it?

Mr. Neuman: Is that the sample he said he made in 1916 or 1917?

Mr. Greer: That is what he said.

Mr. Thiess: We have a little difficulty hearing. Will you read it, please?

(The record as above recorded was read by the reporter.)

(Said bottle containing sample humus, so offered, was received in evidence by the Court, and marked Defendant's Exhibit 18.)

577 Mr. Greer: Q. Doctor Manns, do you know whether or not this Alphano inoculant that you just referred to was ever subjected to a test by the public authorities of New Jersey, the New Jersey Agricultural Experiment Station?

Mr. Rathburn: I object to that, Your Honor. There is no pleading of public use by the Alphano Company. That is not competent in this case.

578 Mr. Greer: Will Your Honor wait just a moment and let's see what the answer says. We have pleaded the Alphano book, which is the book Your Honor has there published by the Alphano Humus Company in 1916, and particularly pages 20 and 21 thereof as a publication showing prior knowledge, not prior use, but prior knowledge of the idea of a composite culture. Now, we are proposing to offer a test by the New Jersey Department of Agriculture on the product which is mentioned in the book which we pleaded as prior knowledge.

The Court: You want to follow this question up with a showing of some sort—

Mr. Greer: That it was a satisfactory article.

579 The Court: (Continuing:)— of what it contained, of its use?

Mr. Greer: Of its use as a satisfactory article.

The Court: Well, why doesn't that bear on the question of knowledge? The knowledge that is conveyed by

this, the article itself must bear some relation to your product in order to be of any importance as knowledge.

Mr. Rathburn: That is pleaded as evidence of prior knowledge.

The Court: Yes.

Mr. Rathburn: It has to stand on its own feet when it is pleaded as a publication of prior knowledge.

The Court: Why not permit him to show what is in it?

Mr. Rathburn: If he wants to prove what is in it, we don't object, but he starts proving somebody placed it on the market when it isn't pleaded.

The Court: Your objection goes to the fact he is not permitted to show the use of it?

Mr. Rathburn: That is correct.

The Court: With that in mind, I will let him answer the question because I think that particular objection is sound.

Mr. Greer: As a public use, yes.

The Court: Well, it is not being received for that
580 purpose.

Mr. Greer: No.

The Court: Do you have the question in mind, Doctor?

The Witness: That is, have I seen reports from the New Jersey Experiment Station showing the results of Alphano humus? Practically that, not verbatim.

The Court: Is that your question?

Mr. Greer: Except Alphano inoculant instead of humus is the only difference.

The Witness: Inoculant. I have seen such report.

Mr. Greer: Q. I will hand you a document and ask you to state what that is (handing document to witness)?

A. This is a report from the New Jersey Agricultural Experiment Station showing the results of seed and legume inoculant inspection for 1922.

Mr. Greer: The defendant then offers this bulletin 377 of the New Jersey Agricultural Experiment Station as Defendant's Exhibit 19 with particular reference to pages 67 to 70, inclusive.

581 Mr. Rathburn: We have no further objection with the understanding that it is offered only in connection with Test Number 240, which appears on page 70 of the bulletin. There are many, many other tests in here that have no relation.

Mr. Greer: I think there is another one in there. It
582 is 274 and 240 on the same page. It refers to the same inoculant. The first one.

The Court: Is that agreeable? It may be marked and received in evidence.

(Said Bulletin 377 of January, 1923, entitled "Results of Seed and Legume Inoculant Inspection for 1922," "New Jersey Agricultural Experiment Stations", "Department of Seed Analysis", "New Brunswick, N. J." so offered, was received in evidence by the Court and marked Defendant's Exhibit No. 19.)

Mr. Greer: Next, may it please Your Honor, we offer in evidence a volume of some of the prior art patents which are pleaded in the answer as anticipation.

First is the Earp-Thomas Patent No. 865,965.

The Earp-Thomas Patent No. 1,099,121.

583 The Bottomley Patent No. 1,106,275.

The Earp-Thomas Patent No. 1,252,332.

The Earp-Thomas Patent No. 1,309,723.

The Thomas Franklin Manns Patent No. 1,320,701.

Mr. Greer: The defendant wishes to introduce this volume of patents as Defendant's Exhibit 20.

The Court: They may be received.

(Said volume of prior art patents, as hereinbefore described, so offered, was received in evidence by the Court, and marked Defendant's Exhibit No. 20.)

Mr. Greer: Q. Now, Dr. Manns, as I understand you, you have made a careful study and examination of the Bond Patent in suit here, have you not?

A. I have, sir.

Q. Do you have a copy of the volume of these patents which we have just mentioned as being introduced?

A. I have.

Q. I will ask you to turn to the Earp-Thomas Patent Number 865,965. Have you examined and studied

584 that patent?

A. I have.

Q. Will you state whether or not you find in that patent any teaching, showing or disclosure of a composite culture comprising different strains of different bacteria of the genus Rhizobium in the inoculant of soil or leguminous plants? That is the Earp-Thomas Patent No. 865,965.

A. I find such reference of a composite culture with a plurality of nitrogen fixing bacteria of the Rhizobium group.

Q. Will you point out to the Court where that showing is made in this patent?

A. It is shown on page 3, column 1, line 57, continuing on column 2 to line 76.

Mr. Greer: Q. What is said there that makes that disclosure, Doctor?

The Witness: May I read?

The Court: Yes.

The Witness: (Reading:)

585 "In the above description, I have assumed that the medium in the distributing vessels is inoculated with one kind only of the nitrogen gathering bacteria. However an important feature of my invention consists in inoculating the medium in each distributing vessel with a plurality of kinds of nitrogen gathering bacteria as will now be more fully explained. To do this, I first form a composite colony of a plurality of kinds of bacteria, by inoculating some medium in a suitable vessel with cultures taken separately from the different stock cultures, thus combining in one culture bacteria suitable for different kinds of plants. After this composite stock culture has been formed, the distributing vessels are inoculated from it whereby instead of each distributing vessel containing only one kind or variety of the nitrogen gathering bacteria, it contains a plurality of kinds. Consequently, such a culture is suitable for use in inoculating the seed of anyone of the kinds of plant from which the bacteria were originally obtained."

586 Mr. Greer: Now, Doctor, will you turn—

The Court: Just what patent is this? Can you tell without going into detail, just generally?

Mr. Greer: It relates to the art of growing and distributing nitrogen gathering bacteria. He says in the first part:

"My invention relates to improvements in the art of growing and distributing nitrogen gathering bacteria."

He teaches he gets them from nature and cultures them and then puts them in a carrying medium or base for use in the growth of plant.

Q. Now, Doctor, will you turn to the Earp-Thomas

Patent No. 1,099,121 and tell us first what that patent relates to?

A. This Earp-Thomas Patent No. 109,912—

The Court: 121.

Mr. Greer: 121.

The Witness: 121. (Continuing:)— shows "Means for Distributing Soil Bacteria".

Mr. Greer: Q. Now, do you find in that patent, Doctor, any teaching, showing or disclosure of the use of a composite culture?

A. Yes, there is shown the use of a composite
587 culture for inoculating soil.

Q. Will you please point out where that is shown and read it into the record?

A. This is shown on page 2, column 1, line 57 to column 2, line 74. May I read it into the record?

> "Soil for inoculating land for growing a particular species of legume may be inoculated with only the particular kind of variety of nodule-forming bacteria corresponding to the particular legume; or the soil may be inoculated with the various kinds or varieties of nodule-forming bacteria belonging to the commonly used legumes, either by inoculating with separate cultures of each different variety of the bacteria or with a composite culture containing the various varieties of these nodule-forming bacteria with which the sterilized soil is to be inoculated. Such composite cultures for inoculating the soil may be produced as set forth in United States Letters Patent No. 865,965, granted to me September 10th, 1907."

588 Q. Doctor, I will ask you to look down lines 87 on the right-hand or second column of page 2 of this patent, and read into the record what the last sentence of that patent is.

A. This is the second patent you are speaking of?

Q. Yes, sir.

A. Give me the lines again, please.

Q. Line 87, in the same paragraph from which you have been reading, and the last sentence in that same paragraph on the right-hand column.

A. (Reading)

> "For example, soil inoculated with bacteria specific

to red clover would answer for inoculating land for
589 growing alsike or white clover."

Q. The red clover, alsike, and white clover belong to the same cross-inoculation group?

A. Yes.

Q. Now, Doctor, what have you to say as to any fundamental difference in inoculating a soil and inoculating the seed of a plant?

A. There is practically no difference as far as reaching the end to be obtained. Both have been in use for many years.

Q. In other words, I understand from that that the functioning of the bacteria is the same?

A. The functioning is the same.

Q. It is a mere matter of convenience as to whether you use one method or the other. Now, I will ask you to turn, Doctor, to the Earp-Thomas Patent 1,309,723—
590 Do you find, Doctor, any teaching, disclosure, or showing of the use of composite culture in that patent? If so, where do you find that showing and tell us what it is. In order to save a little time, I call your attention to page 2, the first column.

A. On page 2, column 1, line 61, to page 2, line 71, we find reference to this—

The Court: You mean column 2, line 71?

The Witness: Column 2, line 71.

The Court: All right.

The Witness: (Continuing) —we find reference to this composite culture.

Mr. Greer: Q. And what does it say?

A. (Reading)

"Virulent cultures of the various bacteria required,
591 either pure or mixed, can be prepared to best advantage by methods set forth, for example, in my prior Patents Nos. 816,850 and 865,965; and inoculation of the prepared peat and phosphate rock mixture therewith can be effected by suitably diluting the agar-agar or other original culture with water, and sprinkling it upon the mixture, which is thoroughly stirred meanwhile."

Q. Now I will ask you to turn to the patent of Thomas Franklin Manns, of Newark, Delaware, No. 1,320,701. Are you the Thomas Franklin Manns of that patent?

A. I am.

Q. What, if any, connection did that patent have to do with the work concerning which you have testified and referred to in the bulletin, No. 116, Defendant's Exhibit 16?

A. The patent is the outcome of the research covered in that bulletin.

Q. Now, what does that patent relate to, Doctor?

A. It relates to the process of reinforcing, bacterizing, and composting organic material for use as in-
592 oculators, improvers, and fertilizer of soils.

Q. Where, if anywhere, do you find in that patent any teaching, showing, or disclosure as to the use of a composite culture in the inoculation of leguminous plants?

A. This is shown on page 2, column 2, lines 69 to 97.

Q. And how is it shown there?

A. May I read?

The Court: Yes, sir.

The Witness: (Reading)

> "Recent scientific knowledge (Bulletin 184, Kentucky Aug. 1914) and (Centralblatt fur Bakt. 40 Bd. No. 11-13—Mar. 1914) has shown that there are only nine species of B. radicicola—"

Mr. Greer: Q. May I interrupt you right there, Doctor? What is meant by that term "B. radicicola"?

A. It was the earlier name applied to the Rhizobium species.

Q. Bacteria?

A. Yes, bacteria. At that time the one term was supposed to cover all the—
593 Q. All right. Now proceed with your reading.

A. (Continuing)

> "——and six of these species or physiological groups cover the inoculation of the most important agricultural legumes. So in practice I employ thoroughly inoculated soil from a legume of each of the six groups, thereby introducing inoculation for all the important agricultural legumes in the one compost. In practice this material has been found superior to the so-called 'pure culture legume inoculating material'. In practice, when it is difficult to obtain the soil well inoculated for the particular legume, I use a pure culture for the same purpose, though the soil gives superior results. In practice I find this product to give thorough inoculation to the following legumes,

viz: alfalfa, sweet clover (white), sweet clover (yellow), black medic or yellow trefoil, bur clover, red clover, mammoth clover, alsike clover, white clover,
594 soy beans, cow peas, sweet peas, spring vetch, garden peas, Canada field peas, lima beans, navy beans, velvet beans, and the various other legumes commonly grown as soil improvers."

Q. Now, Doctor, these six groups that were referred to, state whether or not they are the same groups that are referred to in the Bond patent 2,200,532, on page 1, the right-hand column, beginning with line 30, that he calls there Rhizobium meliloti, Rhizobium trifolii, Rhizobium leguminosarum, and all the rest of them. I will stop there.

A. They are, I believe, the same groups.

Q. Now, just one more question, Doctor. You have been present in the courtroom when the testimony was being delivered here, I believe, have you not?

A. I have.

Q. And you have heard this discussion about garden cultures and field cultures, or garden size cultures and field cultures, have you not?

A. I have.

Q. Will you please state to the Court what your
595 opinion is as to whether or not there is any difference in the functioning and action of bacteria in a mixed garden size culture over a mixture of field size culture.

A. There is no difference, as far as I can see, in the functioning of these bacteria.

Mr. Greer: No further examination.

Cross-examination by Mr. Thiess.

Q. Doctor Manns, as I understand it, since 1912 you have been at the University of Delaware teaching, is that correct?

A. Correct.

Q. And since that time you haven't been associated in any way with the manufacture and production of commercial inoculants?

A. That I have or haven't been?

Q. Have not.

A. I have taken samples from the shelves for examination.

Q. Just a minute, will you answer my question? I

asked you whether you were connected with the
596 manufacture.

A. Not in any way except in the research—

Q. Well, if you will please answer my questions now.

The Witness: Except in the case of humus studies of Alphano peat, in which I manufactured and experimented with such cultures.

Mr. Thiess: Q. You say since 1912 you manufactured cultures?

A. Manufactured inoculating cultures for legumes.

The Court: Not for commercial use, or were they for commercial use?

The Witness: Part of the last batches made were turned over to the Alphano Humus Company.

The Court: All right. I think that is what you were getting at.

Mr. Thiess: That is what I was getting at.

Q. And how much of this inoculant did you make that you turned over to the company?

A. Something like 50 pounds.

597 Q. Just 50 pounds. And you made no other inoculant commercially since 1912 except this 50 pounds which you are talking about?

A. None whatever. Not commercially.

Mr. Thiess: Q. Now, Mr. Manns, what in your opinion is the minimum temperature that is necessary to kill root nodule bacteria and the minimum amount of time required for said temperature? Now, please just give me the temperature and the time.

A. This will vary from slightly above about 70 degrees centigrade, somewhere in there,—

Q. And for how long?

A. — to 75.

Mr. Thiess: Q. Well, you say that the temperature varies from 70 degrees to 275 centigrade.

A. 70 to 75.

598 Q. And how long did you say—what was the minimum time that it would require, at 70 to 75 degrees centigrade, to kill root nodule bacteria?

A. It may be done in 10 to 15 minutes, if properly exposed.

Q. If what?

A. If properly exposed.

Q. Well, I am referring to it being necessarily
599 properly exposed. That is, it is subjected to this temperature. That would be properly exposed, would it not?

A. Right.

Q. And you say it would kill these bacteria in 10 minutes?

A. Yes.

Q. Now, you have referred to the Kroenberger article, do you remember that?

A. I do, yes, sir.

Q. And isn't it a fact that Kroenberger, in his tests, used control pots?

A. Used the what?

Q. Control pots?

A. Explain what you mean by the control pot.

Q. Uninoculated control pots.

A. Yes.

Q. The answer is that he did use them?

A. He did use them.

Q. Now, did not all of his inoculated pots show a substantial increase in growth over his controls, in the Kroenberger article?

600 A. Slight amounts.

Q. You would not say it was substantial?

A. In most of the work, only slight amounts.

Q. Well, are there any indications of a substantial growth, in this Kroenberger article?

A. In some of the legumes, but in the red clover varying amounts; that is, almost within experimental error.

Q. Well, would you say there was none of them that showed substantial growths in the red clover?

A. I would say there is not substantial growth, no.

Q. Is your answer to my question yes or no?

A. No.

Q. Now, you find some additional growth in these pots, and doesn't this fact show, that the additional growth came from the legume bacteria applied and not from the legume bacteria left in the pots because of insufficient sterilization?

A. I would answer that no.

Q. Your answer to that is no. And why?

A. Because the technique is faulty.

Q. Now, the technique is faulty. What particular 601 part of the technique do you refer to now?

A. The sterilization of the soil in the pots, the technique applied to—

Q. Now, just a minute. On that first one, didn't you

just tell me that you could kill all the legume bacteria when they were exposed to a temperature of 70 degrees centigrade and kept there for a period of 10 minutes?

A. I said that.

Q. Well, don't you find the equivalent conditions in Kroenberger?

A. No. He has taken a large amount of soil, sterilized it 25 minutes at 15 pounds pressure. It is impossible for the heat to penetrate that amount of soil and kill the bacteria.

Q. What temperature do you get on steam for 15 pounds pressure above atmospheric?

A. About 250 Fahrenheit.

Q. And can you give it to me in centigrade?

A. About 220 centigrade,—120 centigrade, I mean.

Q. And it is your position that 220 degrees centigrade as used—I beg your pardon, 120 degrees centigrade,
602 as used by Kroenberger, would not sterilize the soil?

A. It would not, no, sir.

Q. And would not kill the legumes in the soil?

A. No, sir.

Q. And you base that on the fact that if that temperature is applied to the soil—for how long by Kroenberger?

A. 25 minutes.

Q. —for 25 minutes, the heat would not penetrate into the soil far enough?

A. It would not.

Q. And have you made any experiments to determine this?

A. I have.

Q. This particular thing?

A. You say that particular thing. We have dealt with all types of soil and peat combinations.

Q. Well, did you use soil of the type that Kroenberger had, and did you subject it to the temperatures and pressures and time that Kroenberger specifies, and did you find that you didn't get steriliz ion of that sort?

A. Practically so.

603 Q. When you say "practically so", what do you mean by "practically so"?

A. I mean practically the same type of soil, the same volume of soil, the same amount of heat, the same length of heat.

Q. And you say that under those circumstances you did not kill the legume bacteria?

A. No, sir.

Q. Have you got any of those tests available?

A. I have not here.

Q. Where were these tests made?

A. Made at the University of Delaware.

Q. And are the tests available there?

A. They are tests that are given to class work throughout—

Q. No, I am asking you whether these tests are available, that you said you made.

A. We have data that—

Q. Can't you answer that yes or no?

604 The Witness: We have data to show that in the length of time given the soil would not be sterilized to kill the legume bacteria.

Mr. Thiess: Q. And you brought none of that data with you?

A. I brought none of that data with me.

Q. You knew that you were going to make this assertion, did you not?

A. No, sir.

Q. You did not know that you were going—

A. I did as soon as I arrived but not at the time I left the University.

Q. Just a minute.

A. Or I would have brought the data.

Q. What was the last statement?

A. I say, not at the time I left the University.

Q. To come here to testify?

A. Yes.

Q. And you had not studied the Kronberger articles before then?

A. No, sir.

Q. You had never seen it?

605 A. Never seen it.

Q. And when did you first look at the Kroenberger article?

A. Since I have been here this week.

Q. Did you look at it the first day you were here?

A. I think probably on Saturday evening or Monday evening.

Q. And after you had read the article you knew that

you were going to make this objection to the Kroenberger tests?

A. I did.

Q. But you made no attempt to get those tests from the University?

A. No.

Q. Now, did you at any time prior to August, 1936, commercially produce and sell the inoculant discussed in your bulletin, Exhibit 19, outside of the 50 pounds you referred to?

A. Did you use the word "sell"?

Q. I said, did you make or sell?

A. Make or sell?

Q. Yes.

606 A. I have made none other than the amounts necessary for the research work, and that which was turned over to the Alphano Humus Company.

Q. And that was the 50 pounds that you mentioned before?

A. Yes.

Q. Did they use that for research work?

A. I beg your pardon?

Q. Did they use that for research work?

A. I could not tell you that.

Q. And would your answer be the same with respect to the inoculant described in your patent that you have referred to?

A. Would the answer be the same?

Q. Yes.

A. That is, that I had not manufactured?

Q. That is right.

A. Or sold?

Q. That is right?

A. Correct.

Q. Now, with respect to this bulletin, Defendant's Exhibit 19, were the tests referred therein—or put

607 it this way: These tests that are referred therein merely show that nodules were formed on the plants, is that correct?

A. It shows that satisfactory inoculation was performed.

Q. Well, that was determined by showing that nodules formed on the plants, was it not?

A. All I have is the report of the New Jersey authorities, and it said they were O. K.

Q. Well, then you don't know how it was done?
A. No, sir. I know the general practice which is used by standard laboratories.
608 Q. But you don't know how these tests were made?
A. No.
609 Q. Now, Dr. Manns, had you, prior to August, 1938, made any search of the scientific literature to determine what information was given as to the effect that mixing different species of Rhizobium would have on the nitrogen fixing ability of every species so mixed?
A. Of every species, did you say?
Q. —so mixed, yes.
A. I have covered the literature fairly carefully. It does not cover every species.
Q. Well, for most species, then.
Mr. Thiess: Change the question to read: for most species.
A. I would say for agricultural species, but not most species.
Q. (By Mr. Thiess) Now, you say you have read the literature?
A. I have read the literature.
Q. You made that sort of a search?
A. I have made that assertion.
Q. You have made that search.
A. I have made that assertion that I have gone over the literature and I am familiar with it.
Q. And when did you make that search?
610 A. From time to time as the literature accumulated.
Q. Oh, in other words, this statement that you are giving me is that you read the literature as it came along and you consider that making a search for this purpose, is that correct?
A. I familiarized myself with the literature as it came out.
Q. So your answer to my question is Yes?
A. Yes.
Q. Now, with respect to this search, can you give me the articles that you know of which are pertinent to this subject matter?
A. There are references—
Q. I don't want a general statement. I want specific references to articles.
A. I cannot give you the exact page and so on, but

Waksman calls attention to it in his book: "MICROBIOLOGY".

Q. How do you spell that?

A. M-i-c-r-o-b-i-o-l-o-g-y.

Q. And what does Waksman say?

A. Waksman refers to it in two places; in one place, speaking of types of organism with one another, possible influence and others, that they do not, is my memory of it.

611 Q. You didn't bring this book with you?

A. No.

Q. Did you know your were going to make this sort of an assertion when you came here to the trial?

A. Not fully, no.

Q. When you say "not fully", what do you mean by that?

A. Covering the literature upon this particular item.

Q. Didn't you know that you were going to expert this art in this patent for some time?

A. I beg your pardon.

Q. Didn't you know that you were going to expert in this trial, and expert this prior art in this patent for some time?

A. Pertaining to the Bond patent, I would say Yes.

Q. And haven't you spent time with your counsel, going over this?

A. Some time, yes.

Q. When you say "some time" haven't you spent some real time with him?

A. A certain amount of time. I wouldn't say any great amount.

Q. Well, you have spent time to go over all this material with him, haven't you?

612 A. Certain amounts of it, certain amounts of literature.

Q. Can you give me any idea how much time you spent with him?

A. On this particular—

Q. No, getting ready to expert in this case.

A. Since Saturday only evenings.

Q. Didn't you talk to him before Saturday?

A. Not with Captain Greer.

Q. Did you talk to somebody in his office?

A. I have had several talks, yes.

Q. With whom?

A. With Mr. Staley.

Q. And you had a number of talks with him prior to that date, did you not?

A. Yes.

Q. And how much time did you put in with Mr. Staley?

A. Pertaining to this item, very little.

Q. I am not asking as to this item. I am talking about generally experting this patent.

A. Possibly parts of two days.

Q. And you have known for how long that you were going to expert this patent?

A. Since some time the past summer.

613 Q. And under those circumstances you knew the points that you were going to make and you could have brought the literature with you, for instance, this book you are now referring to, could you not?

A. I could.

Q. Now, have you got any other literature that you could refer to specifically at the present time that would show this?

A. I have read other summaries dealing with this.

Q. The general statements I am not interested in, Dr. Manns; I want specific references.

A. I have not brought them with me.

Q. Now, here is the Waksman book (handing book to the witness). Will you please point out in this book the two references you have referred to?

A. This is not the book that I referred to.

Q. What is the book that you referred to?

A. "Microbiology".

Q. Is that an earlier book by Waksman?

A. I think it is. What is the date of that one?

Q. 1945.

A. Yes; it is very much earlier.

Q. And you don't believe that that statement is 614 in this later book?

A. I don't know.

Q. You have never read this book?

A. I haven't read this particular book.

Q. Have you read this later book of Waksman?

A. Not fully.

Q. Have you read any of it?

A. I would say that I have not gone over that book.

Q. Have you seen it before?

A. I have seen it but I have not studied it.

Q. Now, in criticizing the Kronberger article you referred to the fact that he used too strong a solution to sterilize his seeds and you stated, referring to—

A. Not sterilize the peat with the solution—

Q. Will you just wait a minute? And you stated in answer to the question: "What would be the effect of using the strong solution that Kronberger used?"

"A. The strong solution that he used would injure the seeds, particularly the smaller seeds."

Now, it is a fact, is it not, that these seeds in the Kronberger experiments germinated in all the pots, including the control pots?

A. He does not give us the amount of germination.

615 Q. But isn't it a fact that they grew?

A. He says they grew but he does not give us the number nor the percentage of growth.

Q. In this Bulletin 115 that you have referred to, did you give the percentage of germination in respect to your experiments?

A. I did not in the sand cultures.

Q. Well, did you give it as to any of them?

A. The experiment as set up in my work covered for the sand cultures 20 of the smaller seeds and 10 of the large to be left in the pots.

Q. Well, what I am asking you, Dr. Manns, is whether in this report of yours you gave the percentage of germination of seeds?

A. I brought mine to a standard—

Q. Can't you answer that question Yes or No?

A. I would say No.

Q. Well; then, if you didn't give it in your tests, why do you criticize Kronberger for not giving it?

A. Because he does not give us the facts pertaining to the seeds, numbers grown.

Q. Well, you didn't give it in your reports; your reports would be subject to the same criticism, would

616 they not? Can you answer that Yes or No?

A. Yes.

Mr. Thiess: That is all on that.

Q. (By Mr. Thiess) Now, on pages 560 and 561 of the transcript of the record, you were asked this question and gave this answer:

"Q. Now, Doctor, will you tell us how you prepared the inoculant which you used in these tests?"

and the answer:

"A. The inoculant which was used in these tests was prepared by getting pure cultures of each of the strains in which we were working on soy beans, cow peas, crimson clover and alfalfa."

Where did you describe that statement in your Bulletin 115, Defendant's Exhibit 16?

A. The description is not given there, as far as I recall.

Q. It is not in your Bulletin?

A. Not in the Bulletin.

Q. Now, doesn't your Bulletin record that inoculation was carried out by using soil, and I refer you particularly to page 6 of that Bulletin?

A. The inoculation was placed in the soil.

Q. Will you kindly read from the Bulletin where 617 it states that, what you have just said?

A. You are speaking of two different types of work here.

Q. Well, will you answer that question first, and then you can explain your answer, if you so desire?

A. State the question again, please.

Q. And I had referred you to page 6.

A. You are referring to page 6?

Q. No, any place in the Bulletin. I thought I would help you by giving you page 6.

A. Dealing with page 6, we are dealing with a series of composts that have nothing to do, whatever, with the inoculant used in the sand cultures.

Q. Can you find that statement at any other place in the Bulletin, referring to inoculants?

A. On page 27: "five different legumes were employed—"

Q. Just a minute. Where did you start reading, on page 27?

A. Page 27, on the 5th line.

A. (reading) "5 different legumes were employed representing as many different nodule organism groups, 618 i.e., alfalfa, clover, vetch, cow peas and soybeans. This work was done in duplicate."

Q. Now, the statement that you have just read,—that refers to the fact that these legumes were placed in the compost that you have referred to, is that correct?

A. These legume cultures were placed in a base that we considered an efficient carrier for inoculant.

Q. And this compost, that is a very heavy fertilizer, isn't it?

A. A very—

Q. A very efficient fertilizer?

A. This compost is a very efficient fertilizer?

Q. Is that correct?

A. I would say No,—not correct.

Q. Well, you made quite a bit of this particular compost, having found a bed of it somewhere?

A. Having found which?

Q. Having found a bed of this compost somewhere?

A. The material was sent me from Summit, New Jersey, as dug from the original beds.

Q. And you considered that very good material to grow seeds in, did you not?

A. As used for trucking?

619 Q. As used for trucking?

A. Yes.

Q. By that you mean for vegetable gardens, etc.?

A. Yes.

Q. And it was used for that purpose and sold for that purpose, was it not?

A. Used for what purpose?

Q. Trucking purposes?

A. The original grounds were. Where the muck was dug from depths of five or six feet, it may or may not include that area.

Q. And that was the muck that you used in your fertilizer referred to in your Bulletin and in your main patent, is that correct?

A. As the basis of the compost, the raw peat as we get it.

Q. Now, this statement that you read from page 27 of your Bulletin 115 refers to "5 different legumes were employed". That isn't referring to the bacteria, is it?

A. Yes, sir, the cultures of bacteria.

Q. Well, it says: "5 different legumes were employed

representing as many nodule organism groups". You say that refers to bacteria?

620 A. That refers to cultures taken from those legumes.

Q. Going down a little further, dropping down about four or five lines where you state: "The appearance of the legumes was somewhat better where 100 pounds and 500 pounds respectively of the composts were used."

A. Correct.

Q. How were you using legumes there?

A. The compost base that was used for the inoculant.

Q. I am merely asking you how you are using the word "legumes" there in this second quotation.

A. In the sand pots showing the inoculation—

Q. Does "legumes" in that second quotation refer to the plants?

A. Absolutely.

Q. Why do you say that it refers to the plants in the second quotation and legume bacteria in the first quotation when you use the same word?

A. Because we are speaking of the source of cultures in the first.

Q. Where do you get the idea that you are talking about the source of cultures? Will you please point out in that sentence—

A. We are dealing with five different groups.

621 Q. You say five different legumes were employed.

A. Representing as many as five different nodule organism groups.

Q. But you are referring to the plant groups of the legumes; you are not referring to bacteria.

A. We are referring to cultures taken from those groups.

Q. And you say that that language says that. That is your position?

A. That is my position. I did the work.

Q. Now, on page 562 of the record you refer to the pots and you say:

"We planted this, a 4-gallon pot containing 8 grams . . of this particular compost, and planted it with these several legumes that are mentioned here."

A. 8,000 grams.

Q. Yes; that should be 8,000 grams, should it not?

A. Yes, sir.

Q. And the bacteria were contained in those 8,000 grams, is that correct?

A. I beg your pardon.

Q. And the bacteria were contained in those 8,000 grams of compost?

A. It was. You mean the ones that were used in the inoculant?

622 Q. Yes, the seeds that were inoculated were put in this 8,000 grams of compost.

A. No, sir.

Q. What did you put in that 8,000 grams of compost?

A. This 8,000 grams of compost refers to a series of composts, some 30, which had to do with the preparation of a proper base.

Q. All right; let us see what your testimony says:

"A. Simply to see that they had the proper efficiency, as we would test every strain before using it.

"Q. All right. Then, I believe you had gotten along to putting the inoculant in the compost. Then what did you do next?

"A. We planted this, a 4-gallon pot containing—"

and you now say 8,000—

"A. (continued)—8,000 grams of this particular compost, and planted it with these several legumes that are mentioned here."

Now, what do you mean by that?

A. This is dealing with composts and not with a test for inoculant in seeds.

Q. Well, I didn't ask you that; I asked you whether 623 you didn't plant these inoculated seeds in this compost, in these 8,000 grams.

A. Not the inoculated seeds.

Q. Well, what did you put in there?

A. This crude, this raw peat, 8,000 grams, was composted with various amendments to which 25 pounds per ton,—at the rate of 25 pounds per ton of a soil inoculant was added.

Q. And then you put the seeds in that combination, is that correct?

A. In these several composts that were variously amended, yes.

Q. Well, it is a fact in your experiments you filled the jars with composts, do you not?

A. Nearly filled.

Q. And then you inoculate the seeds, do you not?

A. No, this had nothing to do with inoculating the seed. The compost was inoculated with 25 pounds,—at the rate of 25 pounds per ton.

That has nothing to do with the studies further on dealing with an inoculant for seed.

Q. Then you inoculated the compost?

A. Correct.

Q. And then you planted the seeds in the inoculated
624 compost, is that correct?

A. Correct.

Q. I want to refer you to this page 563.

The Court: You are speaking of the record in this case?

Mr. Thiess: Yes; the record in this case.

Q. (By Mr. Thiess—continued) At the bottom of the page, you refer to certain tests that you made, and you say,—you answered the following questions as follows:

"Q. How did you examine them, Doctor, for inoculation—I mean for nodulation?"

And your answer:

"A. We pushed the soil away from the roots and examined them visually."

A. Washed the soil away, it should be.

Mr. Thiess: All right; we will take that amendment.

Q. (reading):

"Q. Visually?

"A. Yes. The notes state that, under 'Cow peas' 'abundant, very large'; Soy beans, 'good, large'; 'Crimson clover', 'medium, small,' nodules; and Alfalfa, 'abundant, very large'."

Now, those results were obtained in using an inocu-
625 lated compost, were they not?

A. Correct.

Q. That did not refer to the sand test that you have in your Bulletin?

A. That was not for what?

Q. That did not refer to the sand test that you referred to in your Bulletin?

A. No, sir.

Q. Now, in your yesterday's testimony referring to your tests, page 564 of the transcript, you said:

"If it was rooted in a sand series, it would mean, if your plant were showing very nice and green, that there was a heavy fixation of nitrogen."

As a matter of fact, Dr. Manns, your plants were planted in a soil carrying plenty of nutrients and not in sand, is that correct?

A. Are you speaking of the sand inoculation?

Q. I would like to refer you to page 20 of this Bulletin, the test of 25. It was the test we were just talking about.

A. I have it right here.

Q. Have you got the page?

A. Yes.

Q. Your answer is Yes, is it?

626 A. That there was plenty of nutrient,—is that the question?

Q. Yes.

A. Sufficient for fair growth.

Q. That there is plenty of nutrient and they are not planted in sand?

A. Correct.

627 Mr. Thiess: Dr. Manns, have you the Bond patent in suit, there?

A. I have a copy.

Q. Now, will you refer to page 6 and the table contained on that page?

A. Yes.

Q. Now, there is, is there not, a significant difference as between series 2 and 4 reported in the table of the Bond patent, both of these series having strains of clover bacteria?

Mr. Rathburn: The same strains.

Mr. Thiess: Q. (Continuing:) Well, make it the same strains of bacteria?

A. There is a significant difference, is your statement?

Q. Yes. I said there is a significant difference reported in that table?

A. There is reported, yes.

Q. And if there is such a significant difference, then, the table demonstrates an inhibition or reduction, does it not?

A. I would say the data is too scanty to show that.

Q. Can't you answer my question, which is based on the previous question?

628 The Witness: Would you kindly point out where he says or it states a significant difference?

Mr. Thiess: Q. I am asking you whether that table does report a significant difference.

The Court: That is, between series 2 and 4?

Mr. Thiess: Yes, and he just said that the table did report a significant difference, and then my present question is:

Q. If this table does report such a significant dif-
629 ference, then, the table does demonstrate an inhibition or reduction due to it, does it not?

The Witness: I didn't understand the question as first put to me.

A. I would say that the table as set up does not give significant difference.

Mr. Thiess: Q. Does it report a difference?

A. It reports a difference.

Q. Well, why do you say it is not significant?

A. Because it does not, in my judgment, meet the standard tests for significance.

Q. And will you qualify that a little bit more? I don't know what you mean by that, the standard test for significance?

A. Well, we have several tests, and the data, to me, appears—

Q. I am confining it to the data on the table. Does the table as set out in the patent indicate a significant difference; between 2 and 4, you understand that?

A. Between 2 and 4? Between 2 and 4?

Q. Yes. What about it, is there a significant difference reported in the table?

A. It is reported in the table—that is, it is not
630 reported, but it indicates there.

Q. All right. Now, that being the case, if there is a significant difference reported, as you have just stated there is, then that demonstrates, does it not, as far as what

is reported in that table is concerned, that there is an inhibition or reduction, does it not report that?

A. I don't accept the interpretation.

Q. Well then, if even though it does report a significant difference, it is your position that it does not show inhibition, is that correct?

A. From the data given, it is too scanty to draw proper conclusions.

Q. Then, your answer is that the data reported in this table as to series 2 and 4 does not demonstrate a difference so as to show inhibition, is that correct?

A. That would be my interpretation, that the data is too scanty.

Q. Well, can't you answer that last question of mine yes or no?

A. I hesitate to answer it either way.

Q. In other words, you can't give me an answer yes or no?

A. The data is too scanty.

631 Q. Can't you just answer that one? Whether you can or not, you cannot give me an answer yes or no? Can you answer that one yes or no?

A. No.

Mr. Thiess: Your answer is "No"?

A. I cannot give you yes or no.

Q. And will you refer to the table and tell me whether or not there is not reported on the table no significant difference between series 3 and 5, both series having a second set of clover bacteria strains? Now, I am again asking you to take the data reported in the table and answer the question on that basis?

A. The variations again in 5 is so great that I would not give the answer yes.

Q. Then, your answer to my question is that there is no data in this table to show no significant difference between series 3 and 5, is that correct?

A. I would say that is correct, there is no significant difference.

Q. Well, in that answer do you mean to tell the Court that there is no significant difference between series 3 and 5, or that there is a significant difference, or that

632 they are the same?

A. The variation is so great that it is impossible for me to say that there is significant difference.

Q. How, you say that the variation is so great; that is what you meant?

A. Yes.

Q. Now, coming to the patents, prior art patents, you studied these patents and are thoroughly familiar with all of them, are you?

A. Quite familiar.

Q. And do you subscribe to the statements, scientific statements made in this first Earp-Thomas Patent No. 865,965?

633 The Witness: In part.

Mr. Thiess: Q. Well, to which ones do you not subscribe? Please enumerate them, each and all of them.

The Witness: His means of growing is on—

Mr. Thiess: Q. (Continuing) Would you just read to me from the patent the ones that you do not subscribe to, all of the ones that you don't subscribe to?

A. "The advantage of the solid medium"—

Q. Where are you reading now?

A. On page 3, column 2, line 42.

The Witness: Column 1, I mean.

(Continuing): "The advantage of the solid medium is that there is less danger of spilling the same in handling the vessels prior to sealing and hence less care is required in placing them in the incubator."

I do not subscribe to the artificial culture as a means of—

634 Mr. Thiess: Possibly I can shorten this. You say you have studied these patents and are familiar with them. Are there any other outstanding passages in this patent, which you ran across when you read it and studied it, outside of the one that you have just mentioned, that you can give me now, that you do not subscribe to?

A. Some of the means of fertilization—

Mr. Thiess: I mean pages in the patent.

The Witness: In this particular patent?

Mr. Thiess: In this particular patent?

A. That is the chief one that I object to, that is, I don't subscribe to—

Mr. Thiess: Yes.

The Witness: —is the solid medium, and then the advocation on top of that of a liquid medium.

Q. Well, that is the only page, wherever that is referred to in the patent, that is the only part of that patent, that you do not subscribe to?

A. The chief part.

635 Q. (Continuing) As expert in this art?

A. Chiefly.

Q. Is that correct?

A. Yes.

Q. Now, let us go to the second Earp-Thomas Patent, No. 1,099,121, and I want to ask you the same question with respect to that patent: Do you subscribe to all of the teachings contained in that patent, from the study that you made of that patent?

A. I object to the use of the term "soil" unless it covers several of the humus types.

It is dealing with ordinary field soils.

Q. Now, Dr. Manns, in reading this patent, didn't you mark it, in order to show any statements that were made in there that were not correct scientifically?

A. I did not mark them.

Q. Well, do you remember any in this patent that are not correct, that you can refer me to specifically, at the present time?

A. There are just differences of technique that I would employ in place of what is given in the patent.

Q. And you consider that technique not good technique—

636 A. It could be improved upon.

Q. —as referred to in the patent?

A. It could be improved upon.

Q. And you would prefer to use your technique?

A. I would prefer to use humus instead of soil, yes.

Q. And at the present time, based on the study that you made of this patent, you have no other outstanding statements in the patent which you consider are not good from a scientific standpoint, is that your position?

A. That is my position.

Q. (Continuing) As a man skilled in this art?

A. Yes.

Q. Did you say "Yes"?

A. I said "Yes".

Q. Now, let us take the next patent, which is the patent to Bottomley, No. 1,106,275. Now, this patent on its face is

directed, is it not, to a treatment of peat for manurial and other purposes?

A. That is correct.

Q. And isn't that the subject matter described and discussed in this patent?

A. Correct.

637 Q. And is there any teachings in this patent with respect to an inoculant?

A. Composite culture.

Q. Where do you find any teachings with respect to the composite culture?

A. (Reading):

"A product richer in nitrogen is obtained if nitrogen fixing organisms"—

I am reading from page 1, column 1, line 30:

"A product richer in nitrogen is obtained if nitrogen fixing organisms as *Azotobacter and Bacillus radicicola* are present in the mass."

Q. Now, that has been known for years, hasn't it, that those bacteria would be advantageous in the soil?

A. Yes.

Q. So that is something that was discovered years ago, in Germany, wasn't it?

A. Quite true.

Q. So that it isn't anything that is new in this patent?

A. That phase of it, no.

Q. All right. Now, let us take the next Earp-
638 Thomas patent, No. 1,252,332. Now, it is a fact, is it not, that this patent is directed primarily to a method of coating the culture, so as to protect it, is that correct?

A. Quite true.

Q. And do you subscribe to all of the statements scientifically made in this patent?

A. I do not.

Q. Well, will you point out in the patent those that you do not subscribe to, and I wish you would read from the patent?

A. Page 3, line 41, "It is desirable also to add a little powdered"—

Q. Page 3, was it?

A. Page 3, column 1.

Q. Line what?

A. 41; (Reading:) "It is desirable also to add a little

powdered boric acid or borax to the material during the drying."

Q. That is the only statement that you do not agree with there?

A. It is one of them?

Q. What?

639 A. It is one of the features I object to.

Q. Well, let us have the rest of them?

A. "The coating obtained"; on the same page, line 53.

Q. In the same column?

A. The same column. (Continuing): "The coating obtained by the use of agar-agar jelly in the manner described is particularly desirable in character."

Q. You don't agree with that?

A. I do not agree with that.

Q. Are there any others that you don't agree with?

A. That is the chief ones.

Q. You do not know of any others at the present time?

A. I think not.

Q. Now, we come to the Earp-Thomas patent No. 1,309,723, and I again wish to ask you whether you agree with the statements made, all of the statements made in this patent, as a result of your study thereof?

A. In part.

Q. Well, which ones do you not agree with?

A. The compost differs somewhat with that that I would consider the best.

640 Q. In what respect?

A. Several of the ingredients. He uses finely ground raw phosphate rock, which I do not believe during the composting would become very much available.

Q. And how would that affect the fertilizer?

A. It would affect the fertilizer; it would affect the compost as a valuable fertilizer.

Q. Now, are there any other statements in this patent that you don't agree with?

A. That is the chief one.

Q. You can't point out any at the present time, others?

The Witness: That is the chief one.

Mr. Thiess: Q. Now, coming to your patent, as I understand it, your patent discloses two products, is that correct?

A. Correct; correct.

Q. And what is the difference between the two products?

A. The one product mentioned, on page 1, line 44, "The first product, which I shall refer to herein as the bac-
641 terial compost, bacterizer or inoculator," that is the product which may be used as the inoculant for composting large amount of composts or for an inoculant on legume seed or soil.

Q. Now, with respect to this compost, reading on from the place where you have quoted, you say "is a rich compost containing all the known beneficial soil bacteria."

A. It originally applies to the flora.

Q. It applies to the flora?

A. Yes.

Q. But it applies to a rich compost, doesn't it, it is a rich compost?

A. "containing", it says.

Q. Yes, but it is a rich compost and it contains all the known beneficial soil bacteria?

A. That is correct.

Q. Then, that compost has a high nutrient value, does it not?

A. Not necessarily.

Q. Well, is that what you have described in your patent, or have you not, that it has a high nutrient value?

The Witness: It—

642 Mr. Thiess: Can't you answer that yes or no? Now, this is your own patent, Mr. Manns. Can't you answer that yes or no?

A. It applies to the compost for carrying these beneficial organisms.

Mr. Thiess: You haven't answered the question. Will you please read the question to him?

(Question read as follows:

"Q. Then, that compost has a high nutrient value, does it not?")

Now, can't you answer that yes or no?

A. I would say not necessarily.

Q. Now, what do you mean by "not necessarily"?

A. Rich compost, meaning that it has all the makeup, that is, not acid, not alkaline; it has the richness of a peat, high in nitrogen, but that nitrogen may not be available.

Q. Now, I am asking you whether in your patent, as you have described this, you have said and described this compost as one that has a high nutrient value? Now, will you answer that yes or no? Can't you do that right off? This is your patent, your alleged invention.

643 The Witness: High nutrient value you asked for?

Mr. Thiess: Yes.

Q. What would you say?

A. I would say no.

Q. Now, beginning on the last line of page 2, you say: "For introducing the legume bacteria"—

The Witness: Line, please?

Mr. Thiess: Q. The last line, column 1, page 2. Have you got it? "For introducing." Have you got it, Dr. Manns?

A. Column 1, did you say?

Q. Column 1, last line of the column.

A. Go ahead.

Q. (Reading:) "For introducing the legume bacteria I use a well inoculated soil upon which has grown the particular legume for which the inoculation is introduced."

Now, when you do this—

A. I haven't followed you now. Is that page 2?

Q. I beg your pardon. I will point it out to you. Page 2, right here, "for introducing".

A. Go ahead.

Mr. Thiess: Will you read it back, please?

644 (The record as above recorded was read by the reporter.)

Mr. Thiess: Q. Now, when you do this, how did you know what the efficiency of the different strains of the soil were that you used for this purpose? Did you or did you not know? You can answer that first.

A. In most cases I used cultures introduced into the soil.

Q. Well, I am referring to this statement in your patent right now where you use soil.

A. Correct.

Q. Well, how would you know? Did you know or didn't you know?

A. I did.

Q. How did you know?

A. Because the organisms were introduced into that inoculant.

Q. No, but you have used the soil which is full of bacteria?

A. Yes.

Q. How did you know what the efficiency of the bacteria in that soil was?

A. We have seen that grow the several different
645 legumes.

Q. You didn't know when you used this soil what its efficiency was, did you?

A. Absolutely.

Q. How?

A. By seeing the soil grown in this inoculant.

Q. Did you introduce the legumes I am talking about there. You say:

> "For introducing the legume bacteria I use a well inoculated soil upon which has grown the particular legume for which the inoculation is introduced."

Now, there were legume bacteria in that soil when you started, were there not?

A. Some.

Q. But you don't know how many or what their efficiency was?

A. No, not all of them. Those that were efficient I introduced by culture.

Q. Now, as I understand it, Dr. Manns, you were familiar with Earp-Thomas' work or patents at the time of the filing of your patent application, is that correct?

A. In part.

Q. Well, you knew of his patent. You said you had
646 been keeping abreast of the literature, did you not?

A. Correct.

Q. And you knew of his work, did you not?

A. Correct.

Q. Now, will you please explain in what respects you invented or claimed when you filed this application to have invented a composite culture different from that of the Earp-Thomas patents?

A. The carrier or base was improved.

Q. And that was your invention?

A. So far as the inoculant is concerned.

Mr. Thiess: That is all.
The Court: Anything further for the defendant?
Mr. Greer: No further examination of Dr. Manns.

647 LEWIS THOMPSON LEONARD, called as a witness on behalf of the defendant herein, being first duly sworn, was examined, and testified as follows:

Direct Examination by Mr. Greer.

Q. Will you please state your full name?
A. Lewis Thompson Leonard.
Q. Where do you live now, Doctor?
A. I live at RFD No. 3, Rockville, Maryland.
Q. Will you please state your training, education and experience in connection with leguminous inoculants, bacteriology and plant pathology?
A. I came into the Agricultural Department in 1904 and was associated with Dr. George T. Moore.
Q. Agricultural Department of the United States?
A. All my experience has been in the United States Department of Agriculture. And I was associated with Dr. George T. Moore in a minor capacity in 1904 and I have been continuing in that line of business, leguminous inoculants, ever since. I am not employed by the Department of Agriculture at the present time. I am retired.
Q. But your experience ran from 1904 to the date you retired?
A. 1904 to 1945.
Q. When?
648 A. January 1st, 1945.
Mr. Greer: Q. Will you state in that connection, Doctor, as to what particular branch of the Department of Agriculture your work was connected with?
A. This work was done— I worked in the Bureau of Plant Industry, the Bureau of Chemistry and Soils and the Bureau of Plant Industry, Soils and Agricultural Engineering. Those are merely changes in name. The work did not change.
Q. Did that have anything at all to do with inoculants for leguminous plants we have been talking about?

A. As I say, the work didn't change. It was inoculation of leguminous plants all through.

Q. What did you have to do with it?

A. In 1916 I was given charge of the inspection work which was an informal testing or informal collection and testing of samples of commercial leguminous inoculants found in stores, and so forth.

Q. And what was the character of that inspection? How was the inspection conducted?

A. It was conducted in the usual manner planting
649 inoculated and uninoculated seed. The seed inoculated with the sample sufficiently to give you something to work on and if the culture produced nodules and good growth and the check did not, the culture was considered satisfactory.

Q. Was there any of this—what do they call it?—the scientific analysis used as the test?

A. Well, we didn't use that. It didn't seem to—as a matter of fact, I don't use statistics at all, if you are referring to that.

Q. That is what I am referring to.

A. If I see and touch I can notice it without statistics, if I see everything before me.

Q. By a visual examination?

A. Yes, all of our work was largely a visual examination.

Q. Has the United States Department of Agriculture issued any official bulletins in that connection?

A. They issued two circulars on the results of our work. That is all that has been issued except one away back with which I had nothing to do.

Q. I will hand you a publication entitled, "Circular 703 of the Department of Agriculture", and ask you if you can identify this as being an official publication of the
650 Department of Agriculture (handing document to the witness)?

A. I can.

Mr. Greer: It is offered as Defendant's Exhibit 21.

(Said document entitled "Circular 703, Department of Agriculture", was marked Defendant's Exhibit 21 for identification.)

651 Mr. Greer: Q. Mr. Leonard, that circular sets

forth, does it not, a method of visual examination in the tests that the Department makes?

A. That is right.

Q. How long has that existed, that method of testing?

A. Well, this method is complete. This method hasn't been in operation for more than three years, but prior to that we used a slightly different method but produced the same results.

Q. Well, what was the difference with the visual examination.

A. It didn't have anything to do with the visual examination of the plant, no, no.

Q. You mean prior to the three years?

A. Considering the two methods we have used, one is automatically irrigated and the other is not.

Q. Well, my point was the method that was used three years ago.

A. The same method so far as examination and results were concerned.

Q. Now, in the discharge of your duties, Mr. Leonard, will you state whether or not you undertook to keep
652 posted with literature or any advance made in this art of inoculants for leguminous plants?

A. I maintained a card index file for official and abstracts of publications coming out on this subject. I don't claim to be entirely familiar with the field, all of the scientific articles.

Q. Well, what would you say, Mr. Leonard, as to whether or not in the year 1938 there was or was not generally believed that one specie of the bacteria for leguminous plants of this genus Rhizobium producing an inhibitory effect upon another species within the same culture whereby symbiotic nitrogen fixation by the plant and the organism was inhibited or even prevented? What would be your statement as to whether or not that was a current belief among bacteriologists and those in this art in 1938?

653 A. I don't know. I never thought there was any inhibition.

The Court: Never mind what you thought.

Mr. Greer: It does not make any difference what your opinion was.

The Court: The answer is he doesn't know.

Mr. Greer: I don't think, may it please Your Honor, that the witness intended that.

Q. The question is do you know whether or not
654 there was a prevalent opinion among those skilled in this art as to inhibition?

A. No.

Q. Now, what can you say—

The Court: Well, in your previous answer, were you answering— did you think the question was whether there did exist such inhibitions?

The Witness: I evidently misunderstood.

The Court: I can see how you would. Your answer now is there was no such acceptance in the art.

The Witness: That is right, not among the people I knew.

Mr. Thiess: Now, I object to that answer.

The Court: That came pretty near making the answer bad, of course. I don't know what he is talking about.

The Witness: In my position I am associated with all these men that are in the business. My work put me in contact with all the men in the business.

The Court: In what business?

The Witness: In this leguminous inoculant business, the commercial business. I visited all the laboratories of the men.

The Court: Were they men skilled in the art?

655 The Witness: They ought to be men skilled in the art.

The Court: You accepted them as such.

The Witness: Yes.

Mr. Greer: Q. Mr. Leonard, what, if anything, can you tell us as to your knowledge of mixed cultures, commercial cultures, comprising a plurality of different strains of the bacteria Rhizobium in one culture, one base or
656 carrying means? What can you tell us, if anything, as to whether there have been such products on the market in the United States?

A. There have been such products on the market in the United States.

Q. Do you have in your possession any literature as to any particular one?

A. Not right now, no.

Q. I will hand you a pamphlet entitled, "Nitrogen from the Air Converted Into Food for Plants by Ferguson's Nitrogen Bacteria". What can you tell us as to your information as to that circular? Where did that come from? (Handing pamphlet to witness.)

A. That circular came from the file I made in the Department of Agriculture over a long period of years. I can't tell you exactly where it came from.

Q. How long has it been in the files of the Department?

A. It has been in the files probably since about 1918.

Q. Does it have any reference at all to a composite culture for inoculants?

A. It mentions "Ferguson's Nitrogen Bacteria, A Composite Culture".

Q. Do you know Dr. Ferguson?

657 A. I knew Dr. Ferguson personally.

Q. What can you say of whether, to your knowledge, Dr. Ferguson had any inoculant on the market in the United States prior to 1936?

A. I know he had this particular composite culture on the market.

Q. That is referred to in this circular?

A. That is right.

Mr. Greer: The defendant offers this circular in evidence as Defendant's Exhibit No. 22.

Mr. Thiess: If Your Honor please, we object to this circular, particularly from the standpoint that it is merely an advertisement that was passed out. It contains a number of testimonials from farmers. It is a puffing bulletin put out by a manufacturer and it is merely a self-serving statement made by this manufacturer at the time and there is no proof of its distribution.

The Court: Well, the least you can say for it is, I presume it shows there was offered for sale some 658 composite culture.

Mr. Thiess: I have no objection to having it offered for that purpose.

The Court: Isn't that the purpose?

Mr. Greer: Yes.

The Court: It says a composite culture on the outside, but I don't know what it is or what it is composed of.

Mr. Greer: The particular part we are relying upon is on the first page.

"A Composite Culture. One bottle available for all legumes."

And upon the back part are:

"Prices of Ferguson's Composite Culture Nitrogen-Fixing Bacteria. Available for Clovers, Alfalfa, Beans,

Peas, Vetches, Lupines, Soy Beans, and all other Legumes."

The particular portions in here that I expect to rely upon are pages 5 and 6 where a paragraph is devoted to the comparative efficiency of Ferguson's composite bacteria with other bacteria.

Mr. Thiess: We object to that in an advertisement of this kind, if Your Honor please. If they want to
659 make that sort of comparison or if they want to bring this Ferguson's composite culture into this picture, except as has been testified by this witness that he saw it and it was made, the man should come in and tell about it so he could be subject to cross-examination.

The Court: I didn't quite follow you on that last page. What was that?

Mr. Greer: (Reading:)

"Comparative Efficiency of Ferguson's Composite Bacteria With Other Bacteria."

We are merely relying upon it as the publication showing there was a composite culture.

The Court: Exhibit 22 is received in evidence for the limited purpose of showing there was something called a composite culture for legumes on the market prior to 1938.

Mr. Greer: Yes.

(Said pamphlet entitled "Nitrogen from the Air Converted Into Food for Plants By Ferguson's Nitrogen Bacteria" so offered was received in evidence by the Court and marked Defendant's Exhibit No. 22.)

660 Mr. Greer: Q. Mr. Bond, when on the stand, cited two articles by Lewis T. Leonard and W. R. Dodson, one of them, and the other some tests with Soil-Grow by Lewis T. Leonard.

I will hand you first the article on the effects of non-beneficial nodule bacteria on Austrian winter peas as reprinted from the Journal of Agricultural Research, and will ask you to look at the article and tell us the purpose of it, and whether or not there was any opinion expressed by you there as to the inhibition of a plurality of cultures as is set up in the Bond patent?

661 I would like to introduce it in evidence.

The Court: Have it marked Defendant's Exhibit 23. And it is conceded that that is the article Mr. Bond referred to without offering it, as you say, in evidence?

The Court: It may be received.

662 (Said article entitled "The Effects of Nonbeneficial Nodule Bacteria On Austrian Winter Pea", "By Lewis T. Leonard and W. R. Dodson", so offered, was received in evidence by the Court, and marked Defendant's Exhibit 23.)

Mr. Greer: Now, Mr. Leonard, will you please explain this to us?

A. The point in question involves a species of Rhizobium Leguminosarum.

663 Q. And this combination of organisms represent the combination of an inefficient species, or inefficient strain of this same species, with an efficient strain of this species; and what would be the effect of that mixture?

A. The effect would be that the inefficient strain would drag down the efficient strain in the ultimate result. I mean, the ultimate result would be the product of the two organisms working on the plant. Now, I think it is fair— I don't know whether you will object to this or not, but it seems to me that I should explain that in Mr. Bond's patent the organisms combined are of different species.

Q. Yes, sir.

A. These are the same species.

664 Mr. Greer: Q. I hand you now another paper purporting to have been written by Mr. Lewis T. Leonard, under the title "Some Tests with Soilgro". Are you the Lewis T. Leonard referred to there?

A. I am.

Q. You heard Mr. Bond's testimony in which he made reference to that article, did you?

A. I was here.

Mr. Greer: Well, I think, may it please your Honor, we will offer this in evidence as Defendant's Exhibit No. 24.

(Said Article, headed "Some Tests With Soilgro", by Mr. Lewis T. Leonard, so offered and admitted in evidence, was thereupon marked as Defendant's Exhibit 24.)

665 Q. Mr. Leonard, what was the purpose of that article?

A. That article involves fraudulent material, and I

think if I am permitted to read a paragraph in there it will indicate what it is.

(Article handed to the witness.)

This is the last paragraph on page 624, next to the last paragraph, the second sentence in the paragraph.

Mr. Thiess: Q. You say 624?

A. Page 624. (Reading)

"The packages contain two 1-gallon cans of similar rectangular shape, one green in color, holding the bacteria, the other brown, containing the 'bacteria food.'

"The liquid is light brown in color, smelling somewhat like a weak rain water solution of manure. In this respect, it resembles Nitrobacter Soil Vaccine which was recently on the market and which was found to be practically worthless. The bacterial food consists of sandy soil mixed with rotted manure, containing about 40% moisture. Plant stems and balls of manure covered with a white substance, presumably lime, were noticeable. The material is not homogeneous."

666 Q. Can you find in that article any reference to the doctrine of inhibition?

A. Nothing regarding inhibition.

Q. Have you examined the article referred to by Mr. Bond, a German article by Bredemann?

A. I have looked it over.

Q. Now, without offering this article in evidence, I just want to read the first paragraph and ask you if you are in accord with that, reading:

"N content (column 8) of the harvest is not influenced through the inoculation; in some cases there occur small increases in the percentual nitrogen content, and in other cases small decreases, but both of them irregularly, so that no conclusions can be drawn with respect to the influence of the inoculation."

Is that a correct translation from that article?

A. I don't know about that, but if it is a correct translation the author explained the material himself, or explained the condition himself.

Q. Have you examined the article by Paul Emer-
667 son, which was referred to by Mr. Bond in his testimony?

A. I have seen it a long time ago.

Q. Can you tell us whether or not there is anything

in that article that advocates the theory of inhibition between the various bacteria of the Rhizobium genus?

A. The only nodule bacteria mentioned here in the table 10, page 142, is that of soy beans, so there is no question of a combination of legume bacteria.

Q. Well, now, have you examined another article that was referred to by Mr. Bond, by Gerlach and Vogel, I believe it was, a German article?

A. I have seen it.

Q. What would you say from your examination of that article, Mr. Leonard, as to whether there is any acceptance of a theory or doctrine of inhibition in these inoculants?

A. The author in a paragraph in there states that he hasn't come to a definite conclusion and that he should do more work to find out whether what he did was correct.

Mr. Thiess: Q. That is with respect to inhibition?

A. Yes.

668 Mr. Greer: Q. From your examination, Mr. Leonard, could you tell us whether or not there are any differences in the functioning of bacteria of a mixed culture in a garden size over the functioning of bacteria in a field size inoculant?

A. I only have experience with the two comparisons in connection with peas. We generally test a pea crop all at the same time and that way the peas of garden culture are growing at the same time as the peas that are treated with the single culture, and I haven't noted any particular differences between the two.

Mr. Greer: You may take the witness.

Cross-Examination by Mr. Thiess.

Q. Mr. Leonard, did you make any search of the literature?

A. About what?

669 Q. To ascertain whether or not there was inhibition?

A. No.

Q. And did you make any tests to ascertain that proposition?

A. Not definite tests, no.

Q. Now, you have referred to this inspection that you gave these plants for the Government?

A. Yes.

Q. And you referred to it as an informal inspection.
A. Yes.
Q. Am I right in saying that you make this inspection for the Government because it would be too large a job to give these plants a real scientific inspection whereby you would make a nitrogen analysis in a chemical way?
A. Yes, it is too large a job for that. I mean—
Q. And isn't that the reason that you use this informal inspection?
A. That has nothing to do with it. The informal inspection refers to the fact that it is not a legal inspection or proposition. We don't prosecute anybody. If we find poor cultures we notify them of that fact and co-
670 operate with them in the matter of any mistakes or errors that might be in the culture.
Q. You would agree with me, would you not, that if you really wanted to know definitely whether there was a difference there of nitrogen fixation of between 10 to 30 per cent, you would have to make a chemical test?
A. Possibly so.
Q. What did you say?
A. Possibly so, but it is not done very much.
Q. Well, it is not done in the laboratories because it is too large a test to undertake by these experimental laboratories?
A. Yes. I run about 15,000—I used to run about 15,000 vegetation tests in one year, and if you ran a nitrogen analysis on all those you would be wasting all your time on nitrogen analyses.
Q. That is what I had in mind. Now, I would like to refer you to a paper entitled "A Simple Assembly for Use in the Testing of Cultures of Rhizobia", which I understand, according to this paper, was written by you. You are the author?
671 A. That is right.
Q. And it was published in Volume 45, No. 6, June 1943, of the Journal of Bacteriology, is that correct?
A. That is correct.
Q. And may I call your attention to page 521, where you are discussing sterilization, and you say, "The complete assemblies may now be placed in the sterilizers and subjected to steam under 15 pound pressure for one half hour." You consider that good sterilization, do you not?
A. Yes, sir, when it is pure sand and the soil wet.

Q. And if it isn't pure sand, to what extent would you have to increase that sterilization?

A. Well, if it were—you see, these are small jars, you understand, and the sand is wet and the steam penetrates. If the sand were not wet we would probably have to sterilize an hour, but the sand is practically sterile before we put it in there. It is not like a peat preparation where it is full of organisms, or a soil preparation.

Q. Well, a legume bacteria, if subjected to a temperature of what centigrade for a period of about 10 minutes, would be killed?

672 A. Well, that depends on in what condition they are. If they are in a liquid they would die quicker than if they were on seed, in a dry condition.

Q. Well, let us take both of them. First let us take the liquid condition.

A. About 50 degrees.

Q. Centigrade?

A. Centigrade.

Q. And for how long?

A. Oh, about 15 minutes.

Q. And if it was on a seed how long and what temperature?

A. About 70 degrees.

Q. Centigrade?

A. For three hours.

Q. Centigrade?

A. Yes.

Mr. Thiess: That is all.

Mr. Greer: May it please your Honor, there is one question I would like to ask Mr. Leonard that I really should have asked on direct and overlooked.

The Court: All right.

673 *Redirect Examination by Mr. Greer.*

Q. Have you made any investigation at all, Mr. Leonard, looking toward the question of whether there has been an increase or decrease of sales of inoculants in the country since 1937?

A. Well, I think there has been, and I conducted a survey in 1940 which indicated that fact.

Q. That there was a general increase in sales?

A. General increase, yes.

Q. Was that in any proportion at all or was it slight?
A. Why, it was probably a third more than earlier.
Mr. Greer: That is all.
(Witness excused.)
The Court: Call your next.
Mr. Greer: Dr. Hofer. I think, may it please your Honor, this will be my last witness.

ALVIN WILLIAM HOFER, a witness on behalf of the defendant herein, having been first duly sworn, testified as follows:

Direct Examination by Mr. Greer.

Q. Will you please state your name, age and residence?
674 A. Alvin William Hofer. My business address is New York State Agricultural Experiment Station, Geneva, New York. My age is forty-two.
Q. And what is your business?
A. I am engaged in the inspection of commercial legume inoculants, for the State of New York.
Q. I did not understand your answer to the first question. Did I understand that you were a bacteriologist?
A. I am a bacteriologist.
Q. And what is the inspection that you do in the State of New York?
A. The Inspectors for the State Department of Agriculture and Markets go out into the state where the farmers buy their cultures, and purchase samples for inspection. Those samples by law are delivered to the experiment station for inspection. That is my work.
Q. Would you tell us whether or not you keep up with the current literature and publications relating to inoculants of this character?
A. I do, and I would furthermore say that I do it almost religiously because we have a very good system
675 at the experiment station for bringing to our attention current articles.
Q. And how long has that been the case?
A. Ever since I have been there, I know.
Q. And how long have you been there?
A. Since July 1, 1931.

Q. Well, now, Doctor, I would read you from the Bond patent the statement appearing on page 2, the left-hand column, beginning at line 74.

"It was generally believed that one species—"

That is referring to the species of Rhizobium bacteria.

"It was generally believed that one species produced an inhibitory effect on another species within the same culture, whereby symbiotic nitrogen fixation by the plant and the organism was inhibited or even prevented."

What have you to say as to the accuracy and correctness of that statement?

A. Neither I nor any other scientist that I know engaged in this work, with the exception of Mr. Bond, 676 subscribes to that belief.

Mr. Thiess: I object to that answer, if your Honor please. He says "with the exception of Mr. Bond." He does not know all the scientists.

The Witness: I said all that I know in this field.

Mr. Thiess: He can say all that he knows but he can't say "all that I know with the exception of Mr. Bond." I understood it meant all the scientists under those circumstances.

The Witness: All that I know, that are working on the subject.

The Court: He said all that he knew.

Mr. Thiess: And you know Mr. Bond?

The Witness: Yes, sir.

Mr. Thiess: I see.

Mr. Greer: Q. I will ask you whether or not you have made any research or investigation among scientists for the purpose of determining whether or not there was such a belief?

A. Such a research was made a month or two ago, and these letters directed to the foremost men in this field showed that these men are unanimously of the 677 opinion that there is no such thing as this inhibition.

Q. Will you kindly give us the names of such scientists or men that you made this research with?

A. The first is Dr. Waksman. Dr. Waksman is an authority in this field of work of antibiotic effects of organisms against each other, and furthermore—

Mr. Thiess: If your Honor please—

The Court: The question merely asked the names and don't dissertate about their qualifications.

The Witness: Oh, excuse me. Dr. S. A. Waksman, New Jersey Experiment Station; A. G. Lockheed, Ontario Experimental Farms, Ottawa, Ontario; Dr. A. G. Norman, Iowa State College, Ames, Iowa. I have some more on the list there. I don't happen to have this list with me.

Mr. Neuman: Before he continues with his answer, I think it is entirely improper for him to testify that he contacted these men and what they told him.

The Court: I am not going to permit him to tell what these men told him. He has answered that this theory of inhibition was not accepted by so and so generally. Now, the question is—

Mr. Greer: What makes him say that.

678 The Court: Well, he is now answering that he consulted these men.

Mr. Greer: Yes, sir.

The Court: That is all I am going to permit him to say on that. I presume that is all he will ask, I don't know.

Mr. Greer: Well, I was next going to introduce the letters from the men, not for the purpose of what is contained in the letters themselves but in corroboration of his statement that he had made this investigation among scientists in this country.

The Court: Well, isn't that a matter for them to come before the Court, to appear and testify?

Mr. Greer: As to any facts in the letters, yes, sir. I am not offering the letters for proof of the facts in the letters but proof and corroboration of Dr. Hofer's statement that he had made this investigation among scientists in the country.

Mr. Thiess: If your Honor please, he has testified that he has interviewed these gentlemen, and I don't see any reason to encumber the record with these letters.

Mr. Greer: If it will not be disputed I will agree with you.

679 The Court: Well. I will let him finish his list of names, if he hasn't already.

The Witness: G. G. Pohlman, West Virginia; W. A. Albrecht, of the University of Columbia of Missouri.

Mr. Greer: Q. Anybody from Canada?

A. Yes, I have Dr. Lockheed. I think there were two or three more but I cannot recall them at the moment.

Mr. Greer: I would like, may it please your Honor, to offer these letters as Defendant's Exhibit 25.

The Court: Letters from these persons that were named by the witness?

Mr. Greer: Yes, sir.

The Court: Is that what they are?

Mr. Greer: Yes, sir. That will be 25, A, B, C, D, E, F, G, and H inclusive.

Mr. Neuman: We renew our objection to the offer.

The Court: The objection will be sustained.

Mr. Greer: I will have them marked.

(Said documents were marked as Defendant's Exhibits 25-A, 25-B, 25-C, 25-D, 25-E, 25-F and 25-H, for identification.)

680 Mr. Greer: Q. Now, Dr. Hofer, can you tell us whether or not you have conducted any tests on the question of this symbiotic relationship between various strains of bacteria?

A. Yes, I have.

Q. Where and when were those tests conducted?

A. Those tests were made in the greenhouses of the New York State Agricultural Experiment Station this past winter.

Q. Have you any report showing what those tests were?

A. Yes, I have.

They were begun the middle of September and concluded about the 20th of February. I think the exact date in September was the 17th, I am not absolutely certain as to that.

The Court: Last September?

The Witness: Yes.

Mr. Greer: Q. Will you relate to the Court as briefly as you can, Doctor, what these tests were and what
681 was the result of them? I don't mean the details; just give us a general summary of what the tests were.

A. The test was for the purpose of determining whether or not such inhibition actually does occur. To conduct the tests I wrote to Mr. Leonard, of the U. S. Department of Agriculture, simply asking him for five effective strains for sweet clover, red clover, and soy beans.

Q. Do they belong to different cross-inoculation groups?

A. Yes, they do. When these cultures arrived they

were used to make inoculants in which each of the cultures was grown as a single strain. At the same time inoculants were prepared on an agar surface, in which these fifteen strains of bacteria grew in intimate contact with each other, and they were allowed to remain there and grow in that way for a period of two weeks. At the end of that time the cultures, the bacteria, were removed by adding 100 c.c. of sterile water to each of these bottles. The culture was mixed thoroughly with the water and 1 c.c. of—two 1 c.c. portions of the material were put into each of the pots in the greenhouse. Because of
682 the fact that the arrival of the cultures had been delayed somewhat, and since it made no difference in the result, the soil was inoculated rather than the seed. This is a practice that has been followed in the past, and scientists agree that it has no effect upon the results.

The plants were grown and I can give you the details of that, if necessary, but an auto-irrigator system was used. The purpose of this was to keep the moisture at the optimum point for growth of the plants. The result was that where the plants had complete nutrition they grew vigorously. Of course, there was no nitrogen added to any of the pots. The soil was low in nitrogen to start with. The appearance of the controls confirmed this, because they made barely any growth. After being kept in the greenhouse until about February 20th, these plants were removed, washed very carefully to remove all the sand from the roots, they were dried and weighed and analyzed for nitrogen. The series that was run through completely from end to end was a series of red clover plants.

683 Q. Now, did you take any photographs of those plants while these tests were going on?

A. Yes, I did.

Q. I will hand you a set of three photographs and ask you to explain what each one of those are.

684 Mr. Greer: I will have the first one marked for identification as Defendant's Exhibit 26.

(The photograph was marked Defendant's Exhibit 26, being a picture of rows of pots, the front row of same bearing the following numbers on individual pots: 3, 4, 2, 0, 1-5, 5, 1, 5, 4, 1-5, 0, 3, 2, and 1.)

Mr. Greer: I will have the next one marked for identification as Defendant's Exhibit 27, showing the numbers on front of the pots as follows: 1, 1-5, 0, 3 and 2.

(The photograph showing pots with plants in same and showing the following numbers in front of the pots: 1, 1-5, 0, 3 and 2 was marked Defendant's Exhibit 27 for identification.)

Mr. Greer: And the remaining one I will have marked as Defendant's Exhibit 28.

(The photograph showing pots with plants therein was marked Defendant's Exhibit 28 for identification.)

Q. (By Mr. Greer) Explain what Defendant's Exhibit 26 is.

A. Now the large picture was taken by the com-
685 mercial photographer. This represents an experiment in which two kinds of plants were grown. The left half of the table, to the left of that left-hand flask, are sweet clover plants.

On the right are red clover plants and this is how they appeared on December 11, 1944.

Unfortunately due to light conditions the center area appears lighter than the rest but this is not significant because the plants appeared uniformly green with the exception of the two series marked "O", which had no inoculation.

The cultures from Mr. Leonard had simply been marked 1, 2, 3, 4 and 5, and the pots containing the 15 cultures, the composite cultures, are simply marked as 1 to 5. They should be really marked as 1 to 15.

Q. Well, what was in the middle? You said what was on the left and on the right but what was in the middle?

A. There is a vacant space in the middle just above that left-hand flask of water. That is the line between the sweet clover and the red clover plants.

686 Q. Well, now, what does Defendant's Exhibit marked for identification 27 show?

A. Now, which is that,—the one with the numbers?

Q. That is the one with the little "B" on it.

A. This picture was taken the first week in January of the red clover series. It is a rather close-up view of it and gives the details of the growth.

As you can see, the row marked "O" consisting of 8 pots made very poor growth. The other rows appear practically the same.

Q. And what were they inoculated with?

A. These were inoculated with red clover, single strains, with the exception of the control which had not, and the composite culture marked 1 to 5, which had inoculation from the composite culture made from the 15 strains from 3 different groups.

Q. 15 strains from 3 different groups?

A. That is right.

Q. And alfalfa in the group?

A. The alfalfa group was represented by cultures for sweet clover.

Q. Now what does Defendant's Exhibit for identification 28 show?

687 A. That represents simply another picture of these same red clover plants that have just been discussed.

Mr. Greer: Now, may it please your Honor, we would like to introduce these photographs in evidence as Defendant's Exhibits 26, 27 and 28, respectively.

The Court: They may be received.

(The photograph showing rows of pots, the front row of which bears the following numbers on the individual pots: "3, 4, 2, 0, 1-5, 5, 1, 5, 4, 1-5, 0, 3, 2 and 1" was received in evidence as Defendant's Exhibit 26.)

(The photograph showing pots with plants in same and having the following numbers in front of the pots: "1, 1-5, 0, 3 and 2" was received in evidence as Defendant's Exhibit 27.)

(The photograph showing close-up view of plants in pots, was received in evidence as Defendant's Exhibit 28.)

688 Q. (By Mr. Greer) Now, did I understand you to state that you had made a chemical analysis after the harvesting of these plants, to determine the question of nitrogen fixation?

A. That is correct.

Q. And have you a report showing what that analysis shows?

A. Yes.

Q. Will you briefly explain that to the court?

A. This table consists of—

Mr. Greer: We will ask that the table referred to by the witness be marked for identification as Defendant's Exhibit 29.

(The table bearing the heading: CLOVER PLANTS—WEIGHTS EXPRESSED IN GRAMS, and with columns a, b, c, d, e, f, g and h on the left-hand side of table and the columns: Total, Average % N, Total N% 8 Pots, and Total on the right-hand side of table, was marked Defendant's Exhibit 29 for identification.)

689 Q. (By Mr. Greer) Explain that.

A. The left half of that Table represents the weights in grams, the dry weights in grams of these clover plants.

Starting with the figure 1, Tops and reading from left to right, we get the weights of the tops, the dry weights of the tops of the clover plants grown in each of those pots. In the next row down are 1, Roots and we get—

The Court: Wait a minute. Let us see that first line. Which pot has those which were not inoculated?

The Witness: They are at the very bottom, marked "O".

The Court: Well, what is the a, b, c, d, e, f, g and h?

The Witness: That simply refers to the different pots.

The Court: Different pots of the same series?

The Witness: That is right.

A. (continued) The second row, marked 1, Roots, refers to the same thing for the roots,—the dry weight of the roots in each of these individual pots.

The next row down, marked 1, Total, consists of the items in each case, for each pot of the above two figures.

It is the total dry weight of plant material per pot.

690 Number 2 is the same thing for that series; and likewise for 3, 4 and 5.

The same thing is true for the one marked 1-15, which contain 15 strains from three different groups. The one marked "O", that is, O, Tops, was, as in the experiment by Mr. Curie, so deficient in top growth that there was practically nothing there and for that reason the roots and tops were weighed together.

No; excuse me; they were not either. But, as you can see, the tops were very deficient in growth. That arrangement follows the arrangement above.

On the right-hand half of this Table, the first figure under Total, gives the total weight of tops of plants inoculated with Strain 1.

The second figure down gives the total weight of roots.

In the next column, to the right, the top figures gives

the average weight of tops. The next figure down, the average weight of roots, and the third figure the total of these two figures.

And likewise on down the table for all of the different series. The third column, marked: Percent Nitrogen, contains the results of the nitrogen analyses. The tops in this instance contained 3.22% nitrogen. The roots con-
691 tained 2.47% nitrogen, and so on down, till we get to the one marked O, and here is where the roots and the tops were combined, because the amount of top material was so very scanty.

The next column, marked: Total Nitrogen Percent, 8 Pots, is arrived at by multiplying the proportion of nitrogen by the weight, the total weight of plants in that series.

The total amount of nitrogen in the 8 pots—the total amount of nitrogen in the tops from the 8 pots marked inoculated with one culture, Culture 1, was 3.35 grams.

In the roots of that same series the amount of nitrogen was 1.77 grams, giving a total weight of nitrogen present in those plants of 5.12 grams.

If we may go to the last column on the right, we will see that the total amount of nitrogen fixed by Culture 1 was 5.12 grams.

In the 8 pots of Culture 2 there were 4.92 grams of nitrogen.

The plants in Series 3 contained 5.35 grams of nitrogen.

In Series 4 the plants contained 5.25 grams of nitrogen.

In Series 5 the plants contained 5.56 grams of nitrogen, and in the composite culture in which the bacteria
692 had been living intimately for a period of two weeks the total amount of nitrogen fixed by the red clover was 5.89 grams. The row of pots containing—

The Court: You said the total amount of nitrogen fixed by red clover bacteria. There were a lot of different bacteria there besides red clover, weren't there?

The Witness: We do not know whether they fixed nitrogen or not. We assumed that they did not.

The Court: That is the composite group?

The Witness: That is correct.

The Court: When you say it is fixed by the red clover, that is just an assumption that you make, is it?

The Witness: Yes, as you suggest there is, of course—

The Court: You think the other bacteria remained dormant, do you, and have no effect on the red clover?

The Witness: We have felt that way. Now, we have no way of being sure that the alfalfa bacteria might not have helped in some way, or the soybean bacteria. That is an open question.

The Court: All right.

A. (continued) The total amount of nitrogen, if on the basis of 8 pots, present in the control series was 0.218 grams.

693 As you can see, the method was very favorable for nitrogen fixation and the cultures all fixed rather large amounts.

Q. (By Mr. Greer) What was your conclusion from this test as to beneficial or deleterious effect, in the use of a mixed culture?

A. My conclusion is that if there is an effect upon the clover bacteria of having these other cultures present, that effect is beneficial.

Mr. Greer: Now, defendant offers in evidence this page of figures as to the test testified to by the witness, as Defendant's Exhibit 29.

The Court: It may be received.

(The table bearing the heading: Clover Plants—Weights Expressed in Grams, with columns a, b, c, d, e, f, g and h on left-hand side and columns: Total, Average, % N, Total N% 8 Pots, and Total on right-hand side, was received in evidence as Defendant's Exhibit 29.)

694 Q. (By Mr. Greer) Did you have any experience or do you know anything at all about garden sized mixtured cultures of these bacteria for leguminous plants?

A. These garden mixtures have been coming in among the samples sent us by the inspectors for quite a number of years. I think, in fact, the first one came in 1931.

I have made a record of some of those, beginning with the year 1933, I believe.

Q. A record of what, in connection with them?

A. The number of the cultures among those garden samples which were incapable of forming nodules on the plants, and compared that with the number of non-garden cultures, to see whether they were any better or any worse in their ability to form nodules on the roots of the plants

for which they were intended.

Q. Is that the report you have reference to (handing paper to the witness)?

A. Yes.

Mr. Thiess: Now, if your Honor please, I would like to ask the witness what he made this report from. What was your data?

695 The Witness: This report was made from the officially published report.

Mr. Greer: Again that is cross-examination.

Mr. Thiess: It is cross-examination with respect to this exhibit.

The Court: It bears on the competence of the exhibit, I think. I will let you ask him that.

Mr. Greer: All right; I am perfectly willing to let it go in.

A. (continued) This was made from the officially published reports by the State of New York, first through the State Department of Agriculture and Markets, at Albany, and in the last few years, beginning in 1940, I believe, or 1941, through a publication called: Farm Research, which is put out by the Experiment Station. I have copies of those back there where I was sitting.

Mr. Thiess: Now, if your Honor please, he is compiling a report here from the reports compiled by others. There is no way of investigating the accuracy or the veracity of these figures, the conclusiveness of the figures.

The Court: I don't know yet what kind of a report this is.

Mr. Greer: I think if your Honor would let me
696 examine the witness and identify it without interruption, that probably we could get at this with less consumption of time.

Q. (By Mr. Greer) Who prepared this report?

A. I personally conducted all these tests and prepared each of the individual reports to the state authorities upon which this particular summary is based.

Q. And for whom was the report prepared?

A. It was prepared for the State of New York.

Q. And was done by you?

A. That is right.

Mr. Greer: I think that is sufficient.

The Court: It is a test for what, and a report of a test for what?

The Witness: The test is to show whether the particular bacteria said to be in these inoculants are actually there. An alfalfa inoculant, for instance, says: Good for the inoculation of alfalfa plants. And my test was to determine and see whether that culture did contain the bacteria which were supposed to be there.

Q. (By Mr. Greer) Were these the garden sized cultures you were talking about?

A. Both types.

The Court: The garden sized and the field size?

697 The Witness: And the field size.

The Court: Were they all single cultures?

The Witness: The garden sized consist of mixed cultures. It may contain from three to five groups of bacteria.

The Court: This is a test to determine whether the product that you tested had the things in it that it was advertised to have?

The Witness: That is right.

The Court: That is what the State of New York was interested in, whether the public was being defrauded in any way?

The Witness: Yes, to see whether really a genuinely favorable, a viable, a lively, active bacteria was present.

Q. (By Mr. Greer) And whether that functioned or not? Would that enter into it?

A. That is right.

Mr. Greer: That is the point, whether the product was satisfactory or unsatisfactory.

The Court: In this case you are in that respect only concerned with the composite group, aren't you?

Mr. Greer: No, sir; the composite group, yes. We are not interested in the single group at all. In this report

698 he happened to have, as I understand it,—like most of these statisticians,—they make it as confusing as possible, but as I understand it, they have a column of one-plant group, and they have another column of the garden mixed culture. We are not interested in the single group, as far as that is concerned.

700 Q. Dr. Hofer, when you commenced your testimony, I neglected to ask you the usual questions.

Mr. Greer: Q. I neglected to ask you the usual questions as to your qualifications in this field concerning which we are conducting this inquiry. Will you please tell us

what has been your education, training and experience in the art of bacteriology and plant pathology?

A. I was at the University of Illinois, in the College of Agriculture, from 1925 to 1929.

From 1926 to 1929, I was employed in the Division of Soil Biology. It was a very menial task, cleaning glassware and preparing media, but, nevertheless—

Q. Of what state?

A. Illinois. But, nevertheless, heard discussions and participated in discussions concerning soil bacteria.

From there I went to the University of Wisconsin
701 and studied one year under Dr. E. B. Fred, who is now the President of the University, received my Master's Degree in the summer of 1930, and my Bachelor's Degree was received from the University of Illinois.

The second year, I studied under Dr. I. L. Baldwin, who is now the Dean of the Graduate School of the University of Wisconsin.

On July 1st, 1931, I took my present position and while there spent vacations and, under special arrangements, completed the work for my Doctor's Degree at Cornell University. This work was completed in 1937 and was done under the direction of Dr. H. J. Conn, who has been long known in the field of soil bacteriology, and Dr. J. K. Wilson.

Dr. Conn was a part of a 2-man committee who supervised my work at Geneva and Dr. Wilson had charge of that that I did at Cornell. They worked together on the committee.

Q. Just exactly what is your present position?

A. My title is Assistant Professor of Cornell University, because the New York State Agricultural Experiment Station is administered by Cornell University.

Q. All right. Now, Doctor, coming back to this report which I would like to have marked for identification
702 as Defendant's Exhibit No. 30.

(Said report headed "Comparison of Types of Culture Based Upon Tests Made in New York State" was thereupon marked as Defendant's Exhibit No. 30, for identification.)

Now, will you please explain what that report consists of?

A. As stated previously, each year reports are con-

ducted for the State of New York. These are those reports. And from each of these reports, I have taken four figures.

Take for 1933, the total number of cultures for one plant group that were tested was 51.

Q. Does that mean a single strain of bacteria?

A. That is right.

Mr. Greer: Yes.

The Witness: The number of those 51 that were unsatisfactory was 7.

The number of garden cultures that were tested in 1933 was 7.

Mr. Greer: Q. Now, what do you mean by garden culture? A mixed culture or single?

A. A small package that are made for inoculation
703 of peas, beans and Lupines, or peas, beans and lima beans as they were in those days.

Q. Those are cross-inoculation groups?

A. That is right.

Mr. Greer: All right. Go ahead.

The Witness: Now, for each year I have taken out the pertinent figures, in that fashion. I should like to call your attention to the fact that in 1933, '4 and '5, there were a great number of unsatisfactory cultures. The techniques of manufacture had not been well perfected in those days and we found a lot of unsatisfactory cultures among those inspected.

Now, with the exception of two garden cultures in 1937, from one company, the record of the garden culture has been very satisfactory as far back as 1935, with that one single exception.

Mr. Greer: The defendant offers in evidence this report that has been identified by the witness, as Defendant's Exhibit No. 30.

The Court: It may be received.

(Said report headed "Comparison of Types of Cul-
704 tures Based Upon Tests Made in New York State", so offered and received in evidence, was marked as Defendant's Exhibit No. 30.)

Mr. Greer: Q. Going back for a moment, to Defendant's Exhibit 29, which was a report of the results of your tests as to a single culture, as I understand it, and a composite culture, am I correct in my understanding that you used 8 pots in each series?

A. That is right.

Q. (Continuing) In connection with this test?

A. That is right.

Q. Will you please explain to the Court why you used as many as eight pots in each series?

A. I have previously stated that there was nothing in scientific literature or opinion, up to the year 1938, to indicate that there was such a thing as inhibition. Later, the question came up, of course, and in order to avoid errors in an experiment of this kind, it seemed desirable to use that many pots.

Now, plants do not grow uniformly. Each plant is a law in itself, and no matter how a person conducts an experiment like this, there will be a variation from pot to pot, it cannot be avoided. If too few pots are taken, one series may be a little higher than the other and a misleading conclusion drawn. Therefore, it is wise to have quite a number of pots, so that that average will be just about as accurate as it is possible to get it. Now, this has a further advantage, and that is that the formulas used in statistical analyses are so devised that the more pots that are run, the smaller becomes this plus and minus. In other words, the formulas recognize that the more pots that are run, the more accurate the answer; and for that reason, the experiment to be sound, and the matter of statistical analysis was paid no attention to in the end because the experiment was set up soundly from that standpoint.

Q. What would be your opinion, as a scientist, as to the advantages or effective results of a comparison between two series of just where one was 3 and the other was 5, would that have any effect one way or another on it?

A. It would not be a fair test, and furthermore, with only 3 pots, if the test had been repeated, it might have given exactly the opposite result.

Q. Have you ever conducted any tests of the garden types of culture that were on the United States market, in comparison with a test of a single strain of the bacteria that was in the garden culture strain, to determine what effect, if any, was produced by the mixture?

A. You mean as far as nodule production was concerned, or otherwise? I did not get that?

Q. Nitrogen fixation?

A. Nitrogen fixation?

Q. Yes.

A. I have.

Q. I hand you a document, and I will ask you to state what it is, first? Please take this one, that you can keep, as a copy.

A. This is a small report which may sometime be presented for publication. I have not made up my mind, but, it is written in the form of a paper showing the results of comparisons between single strains and mixed cultures for lima beans.

Q. Now, what kind of mixed cultures were used in this test?

A. These were the small garden packages.

Q. And could you give us the names, the trade names of the garden packages that were used?

707 A. These cultures included single strains and mixed strains from the brands Nitragin and Nodogen.

Q. Any other?

A. There was one Legume-Aid, and possibly two more here.

Q. And how did you obtain those garden size mixtures?

A. Those samples were brought to me by the inspectors of the State Department of Agriculture for the routine tests and we are trying to extend those tests so that they will not measure only whether the proper bacteria are present in the culture, but also whether they are going to do what they are supposed to do in the field.

Q. As I understand you, then, these were routine tests that you made in your public capacity?

A. Yes, in the field.

Mr. Greer: I would like to have this report marked for identification as Defendant's Exhibit No. 31.

(Said report headed "Yield of Lima Beans From Two Types of Inoculants" was thereupon marked as Defendant's Exhibit No. 31 for identification.)

Q. Now, will you tell us, Doctor, what was the result of those tests in the comparison as to this question of nitrogen fixation, I mean the comparison between the garden mixtures and the single strain inoculation?

708 A. It should be stated, first, that in any nitrogen fixation experiment, there should be some better

growth by the inoculated plants. If the inoculated plants make no better growth than the uninoculated plants, there is no nitrogen fixation and the experiment is worthless.

In this test, there are sufficient differences between the uninoculated and the inoculated, especially in 1941, that there is little question but what an appreciable quantity of nitrogen was fixed. These plants were planted in rows one yard long each, and were scattered through a plot in accordance with the advice given by statisticians. When the beans matured, they were harvested, picking those in which the pods were full of beans and the quantity for each row was weighed green. The rows were not identified. They were simply picked and identified by their position in the field.

A week or so later, when some more had filled out, another picking was made, and I know, perhaps three pickings were made during the season. That is the way the housewife does it, and for garden use this would be a perfectly logical method.

The test yields as given there in the 1941 figures listed under Average show that there was 968 grams per row 709 in the uninoculated series.

The single cultures produced 1637 and 1397—I think I have the averages here—1517 grams, the average for the single cultures.

The mixed cultures produced 2293 for the average of one field and 1556 for the average of the other, for a total of 1929.

Now, in 1942, the differences were not so great and yet, nitrogen fixation did occur as shown by the fact that there were increases, in fact, every treatment with bacteria increased the yield of lima beans.

Adding up the 2 figures for single cultures, 1892 and 2000, the average for single cultures is 1946.

For the mixed culture test, three figures, 2730, 2335 and 1919, or an average of 2328 per row.

Mr. Greer: All right.

Q. What was the final conclusion that you arrived at from these tests?

A. The final conclusion was similar to the conclusion of the experiment mentioned previously today, that if the various groups of nodule bacteria packed together in one

container had any effect on each other in these in-
710 stances, that would appear to have been favorable.

Mr. Greer: Now, the defendant offers this report as Defendant's Exhibit No. 31.

The Court: It may be received.

(Said report headed "Yield of Lima Beans From Two Types of Inoculants" was received in evidence by the Court as Defendant's Exhibit No. 31.)

The Court: Q. What do you take from the fact that in the third row—

The Witness: Let me see that copy.

The Court: Q. (Continuing)—at least two of them, mixed findings in 1942, were less than the uninoculated row?

A. Well, if a series of uninoculated plants were planted—

The Court: Q. And that is true also of the single lima bean inoculation in one instance?

A. Those always vary, just as any plants vary. That adds confusion to any experiment, so that one simply has to have enough plants to be sure, before he can be sure that he has a conclusion. There were 50 plants in each of these rows of one rod each.

The Court: Q. Well, it is apparent at least in the third row, that the uninoculated did better than either the single or the mixed inoculation, didn't it?

711 A. It did, in that comparison.

Mr. Greer: Q. Well, does that show that in some instances there is no effect or no inoculation at all?

A. That is why we have to use a number of repetitions of these things, before we can approach an accurate estimation, because any of these, if always taken singly, would give a terribly imperfect.

Q. In other words, does a man really know what brings about this nitrogen fixation or not?

A. No.

The Witness: In the field, on what appears to be perfectly level ground, there will be places where water stands, perhaps in a wet season. It would not be apparent at all in a dry season. There will be places where perhaps there is a little better drainage or maybe a dead furrow where the plow has separated the soil and it is a little lower or something, there are all kinds of these things, and it was because of these things that
712 the statistical analysis was developed. Many of these instances we cannot detect and in addition, we have

the hazard that even these individual plants begin growing and a plot will tend to start off according to their own way and there is nothing we can do about it.

The Court: Q. You don't have a failure in the pot test like you would in a field test, do you?

A. I don't know— They vary considerably, but looking at this data that is given, from pot to pot, there is really very great variation.

The Court: Q. Can you tell me, were the nodules present in this row 3 mixed, which has only 1575 grams?

A. In the greenhouse test, nodules were present.

Q. I am asking about this test here?

A. I could not dig up the plant without spoiling the test.

Mr. Greer: Q. I hand you another publication, Dr. Hofer, and ask you to state what that publication is?

A. This is Agricultural Bulletin 292 published by the Department of Agriculture and Markets of the State of New York.

Q. I will ask you to turn to pages 68 to 72 in that publication and tell me who prepared the report pub-
713 lished there?

A. I prepared that report.

Q. What does that report deal with?

A. That is one of the annual reports of the tests.

Q. Beginning on page 68, I mean, what particularly is the subject of it?

A. The heading is LEGUME INOCULANT TESTS FOR 1934.

Mr. Greer: The defendant would now like to offer this report in evidence as Defendant's Exhibit No. 32. I have given the other side a photostatic copy of pages 68 to 72 which I expect to rely upon.

Mr. Thiess: For what purpose is it being relied on?

Mr. Greer: In the first place, to show the method of tests that are adopted in the New York State Department as shown beginning on page 68 and the tests which had been conducted as to the brand of inoculant, the group that it was supposed to cover.

Mr. Thiess: You mean all of these various brands here?

Mr. Greer: Well, if you want to confine it to Nodogen which has been mentioned and Nitragin and Stimugerm, what they show for garden mixtures, is what I am talking
about, and the tests of the garden mixtures of culture
714 covering peas, beans, lima beans, and so forth.

Mr. Neuman: Well, isn't that exhibit, then a

duplication of your summary appearing on DX 30 which shows the tests made in 1934 of garden mixtures?

Mr. Greer: '34—

Mr. Neuman: 1934, you have included that year in your summary.

Mr. Greer: That would show in there, yes, as to those particular tests, but it does not show the method that was used.

Mr. Thiess: Are you limiting it, then, to the methods?

Mr. Greer: To the methods and tests that are shown there, as to the garden mixture cultures, as shown on pages 68 to 72.

The Court: It being so limited, it may be received.

Mr. Thiess: All right.

(Said AGRICULTURAL BULLETIN 292 of November, 1934, Published monthly by the Department of Agriculture and markets of the State of New York, entitled "Report of Analyses of Samples of Seed Collected in New York State July 1, 1933, to June 30, 1934 Also Report on Legume Inoculant Tests Made in 1934 (Pages 68 to 72 inclusive)" was received in
715 evidence, as aforesaid, and marked as Defendant's Exhibit No. 32.)

Mr. Greer: Q. Dr. Hofer, Mr. Bond was asked on his direct examination as to certain publications which he cited as support of belief in a doctrine of inhibition in this art between different species of Rhizobium bacteria, and one of those articles is one which was purported to have been written by H. J. Conn and A. W. Hofer. Are you the A. W. Hofer referred to in that article?

A. I am.

Q. Are you familiar with that article?

A. Yes.

Q. Will you please state to us what the article dealt with?

A. After sending a report such as which was just submitted as evidence—

The Court: He asked you what the article dealt with.

A. That is what I am describing. After submitting that report, those same data were used for a popular summarization to be sent to farmers, to explain to them the results of the tests.

Mr. Greer: Q. Then, Doctor, please state whether or

not there is anything in this article dealing with the
716 problem of inhibition or non-inhibition of cross-strains of Rhizobia bacteria?

A. There is nothing that could be so used.

The Court: Are you introducing that?

Mr. Greer: No. They didn't introduce it. He just simply referred to it, as supporting it, and I was contradicting them by the author himself.

The Court: Well, gentlemen—

Mr. Rathburn: That was not put in to show inhibition. That was put in to show that mixed cultures were unsatisfactory, that article.

The Court: Yes. Mr. Bond says that that was one of the teachings that said that there was inhibition in these strains.

Mr. Greer: That was the reason I was trying to contradict him.

Mr. Rathburn: Mr. Bond has said that this article was one from which he concluded that mixture cultures were unsatisfactory. It was not the specific article that taught him the inhibition feature.

The Court: Maybe I am not speaking of the right one. This is the one that taught him that mixed cultures
717 were unsatisfactory.

Mr. Greer: If they mean that they were unsatisfactory due to inhibition, then, that is competent to contradict, if they are stipulating.

The Court: Now, this witness has said that there is nothing in this article that teaches the doctrine of inhibition. Isn't that about what he said?

Mr. Greer: Yes, that is my understanding of it.

The Court: Well, how am I to determine which one of these witnesses is to be believed in connection with this situation? They each put an interpretation upon it and, without it being put in evidence, how am I going to pass on it?

Mr. Greer: We will be pleased to put it in evidence.

The Witness: I should be pleased to explain, if I may be allowed—

The Court: No. You have already explained with reference to your idea about it, and I know Bond's idea about it, but, here is a clash of views. One witness says one thing and the other witness another.

Mr. Thiess: Well, we will put it in evidence.

The Court: It may be one of the things on which this

case turns, and I don't know about it unless it is
718 put in evidence. It speaks for itself.

Mr. Greer: The defendant will offer it in evidence as Defendant's Exhibit 33.

The Court: That is, the article.

Mr. Greer: Will you mark it. That is the article by H. J. Conn and A. W. Hofer.

The Court: All right. It may be received.

(Said article designated as CIRCULAR No. 137 (Revised) New York State Agricultural Experiment Station, Geneva, N. Y., SOIL INOCULANT SERVICE, by H. J. CONN and A. W. HOFER, dated January 1, 1934, so offered and received in evidence, was marked as Defendant's Exhibit No. 33.)

719 Mr. Greer: Q. Will you read the portion underscored in that article?

A. (Reading:)

"This last year the poor products were often found to be mixed cultures sold in small containers, recommended for garden purposes. Those intended for"—

And there the underlining stops.

The Court: Let me have the exhibit.

720 The Court: (Reading:)

"This last year the poor products were often found to be mixed cultures sold in small containers, recommended for garden purposes. Those intended for the inoculation of soy beans were also of low quality. Further tests are necessary to determine the seriousness of the situation and to learn what measures should be taken to correct it."

Seriousness of what situation, Mr. Hofer?

The Witness: Defects in manufacturing technique that resulted in poor soy bean cultures and in this one out of the fourteen are poor garden cultures.

Mr. Greer: The underscoring in there is as it was received by us from counsel for the plaintiff.

Mr. Rathburn: That was Mr. Bond's underscoring put on there for the purpose of helping him when he was testifying.

The Court: All right.

Mr. Greer: Q. Now, will you state whether or not that had anything to do with the question of inhibi-
721 tion between the two strains?

A. No, it wasn't so intended.

Q. What was it that led you to the report of unsatisfactory conditions as to mixed cultures?

A. Because the cultures did not contain the bacteria that the container said they did have in them.

Mr. Greer: I see. Now, there are some other articles Mr. Bond referred to that have not been introduced in evidence. I don't know how to treat those.

The Court: Have you introduced any oral testimony concerning them?

Mr. Greer: Not yet.

The Court: I am only concerned— I am concerned particularly about them only if there is some other oral testimony which contravenes what he said.

Mr. Greer: My oral testimony would be in strict conflict with what Mr. Bond said about them. They have not been introduced in evidence. I will meet Mr. Bond's statement with my witness.

Q. Have you examined the articles referred to by Mr. Bond in his examination as emanating from Mr. A. G. Lochhead of the Division of Bacteriology of Canada?

A. I have.

722 Q. Did you find anything in that article dealing with the question of inhibition of different strains of the bacteria Rhizobium?

A. Before answering let me separate those into two groups. The first two articles dealt with cultures that were intended for the inoculation of non-legumes plus legumes. And Lochhead makes the statement that these mixtures— I can't quote it exactly, but the sense is that these mixtures are not good and should not be used. Bacteria only should be put into those cultures.

The second two state something more or less concerning the possibility of a culture being suppressed when in combination with other cultures, but he has conducted no tests in which he has used the same cultures as single strains using the same single strains both in the single culture and the mixed culture.

Mr. Thiess: If Your Honor please, I want to inject a question here, if I may. I want to know on what this witness bases his statement that he made no tests from that article.

The Witness: I made tests, but he did not make tests, as my test was reported earlier today, using the same cultures singly and in combination.

723 The Court: Are you telling us what the article discloses?

The Witness: No.

Mr. Greer: Confine yourself to what the article discloses.

Mr. Thiess: I move to strike it.

The Court: Unless it is disclosed in the article about the test, of course, that would be incompetent and will be stricken.

The Witness: The last two of those reports.

Mr. Greer: The question is whether there is anything in those articles.

Mr. Thiess: Those two articles, as I understand, are in evidence as our exhibits.

The Court: The Lochhead article?

Mr. Rathburn: The two he is talking about now are in as Exhibits 12— I guess the second one isn't in.

The Court: Exhibit 12 is a Lochhead article?

Mr. Rathburn: Yes.

The Witness: Exhibit 12 is marked on this one and the second one is the one following.

Mr. Greer: Take up Exhibit 12 first and tell us what you see in that report as a basis for his belief in
724 or disbelief in a doctrine of inhibition between different strains of Rhizobium bacteria.

A. He says:

"Furthermore, cultures containing bacteria for treating legumes of different cross-inoculating groups were unsatisfactory. Where two strains of Rhizobium are mixed in a single culture, there is the probability of one strain being suppressed, and it is therefore recommended that an inoculant contain bacteria of but one cross-inoculation group."

I couldn't state that as evidence that there is inhibition.

Q. All right. What about the other?

A. The other one says:

"Moreover the inoculants containing bacteria for but one cross-inoculation group are believed better than those containing bacteria for two or more legume groups since tests have shown that in mixed cultures one strain may become ineffective."

Q. All right, as a scientist, what would you say as to that supporting a doctrine of inhibition as a general
725 proposition?

A. I would say that would not show there is such a thing as inhibition.

The Court: Well, it shows he thinks there is, doesn't it?

The Witness: Inhibition was not known. He may be thinking that one group of bacteria grew faster. Well, bacteria occur in two divisions, roughly, what we call fast growers and slow growers. He may have believed that in the competition for food, one of this group was lost. There is so little in this sentence that a great many possibilities are possible.

Q. In your research into the doctrine of inhibition, did you have any contacts with Dr. Lochhead?

A. Yes, I had a letter from him shortly before coming here, and that letter is included among those that were submitted.

Mr. Greer: Q. Can you tell me, Doctor, in this research which you conducted whether or not you found any scientist who believed in the doctrine of inhibition?

726 A. No.

Q. Now, I will call your attention to another article which was in German. I don't think it has been introduced in evidence, has it? The German article, you had no translation of it was by— what is the name?

A. Weigert and Weizel, in an article entitled "Observations on the Influence of Previous Crops and Nurse Crops on the Development of Red Clover."

Q. Have you read that article?

A. Yes.

Q. You can read German?

A. Yes.

Q. Please tell us, what, if anything, you find in that article in support or in opposition, either one, to this doctrine of inhibition as to different strains of the bacteria Rhizobium?

A. It does not deal with that subject.

Q. What can you say as to the fact that in the genesis of this art of plant pathology dealing with the Rhizobium bacteria as to the belief originally among scientists with regard to whether there was only one or more than one species of the Rhizobium bacteria?

A. Originally it was believed that there was but

727 one specie.

Q. Now, can you tell us whether or not there is a school of thought in this art that still holds to that theory?

A. There is a growing school of thought that holds to this theory.

Mr. Greer: You may take the witness.

Cross-Examination by Mr. Rathburn.

Q. Dr. Hofer, in connection with these articles by
728 Dr. Lochhead—

A. Which articles?

Q. The last two, the 1934 and 1938. Did I understand you to say that statements you quoted from these two articles couldn't be taken as an indication of inhibition?

A. Oh, possibly someone might take them as a mere indication, but there are other possibilities that would have to be considered.

Q. Inhibition is a possibility, isn't it?

A. It is one possibility.

Q. And it is a fairly logical possibility?

A. No.

The Court: Let me have Plaintiff's Exhibit 12, please.

(Document handed to the Court.)

Mr. Rathburn: It is the last sentence. Will you mark this for identification as Plaintiff's Exhibit 18?

(Said letter was marked Plaintiff's Exhibit 18 for identification.)

Mr. Rathburn: Q. Have you ever seen that letter before? (Handing letter to witness.)

A. Yes, sir, I wrote it.

Q. Is that your signature?

A. Yes.

Q. And you wrote that letter to Mr. Bond?

729 A. I can't remember in what connection, but that is true.

Mr. Rathburn: Will you mark this Plaintiff's Exhibit 20?

Mr. Rathburn: Change this to 19, please.

(Said document was marked Plaintiff's Exhibit 19 for identification.)

Mr. Rathburn: This is Number 20.

(Said document was marked Plaintiff's Exhibit 20 for identification.)

Mr. Rathburn: Q. Dr. Hofer, do you recognize this letter that has been marked for identification as Plaintiff's Exhibit 19?

Q. Is that your signature?
A. Yes, it is.
Q. And you wrote that letter to Mr. Bond?
A. Yes.
730 Q. I believe you said you didn't recall in what connection you wrote the letter, Plaintiff's Exhibit 18?
A. No.
Q. Did Plaintiff's Exhibit 19 refresh your recollection on that?
A. Well, he was asking for information—
Q. Please answer the question.
A. Yes.
Q. The two letters are about the same subject?
A. I don't remember his letter before this one, so I can't remember what he inquired about.
Q. But your letter of July 29th, Exhibit 18, is directed to the same subject as your letter, Plaintiff's Exhibit 19?
A. That is correct.
Q. Is the article by Lochhead published in 1938 in the Report of Bacteriology For the Dominion of Canada the article you were referring to in the letter, Plaintiff's Exhibit 18?
A. Yes, I am sure it is.
Mr. Rathburn: Will you mark this for identifica-
731 tion as Plaintiff's Exhibit 20?
(Said document was marked Plaintiff's Exhibit 20 for identification.)
Mr. Rathburn: I show you a photostat, Dr. Hofer, of a part of this 1938 Lochhead Bulletin. Is the part underlined on the photostat the part you had in mind in calling this thing to Mr. Bond's attention?
A. That is right.
Mr. Rathburn: I now offer in evidence as Plaintiff's Exhibit 18 the letter dated July 29, 1938, addressed to Mr. Bond from A. W. Hofer.
Mr. Greer: No objection.
The Court: It may be received.
(Said letter dated July 29, 1938, addressed to Mr. Bond by Mr. A. W. Hofer, so offered, was received in evidence by the Court and marked Plaintiff's Exhibit 18.)
Mr. Rathburn: I offer in evidence as Plaintiff's Exhibit 19 a letter previously marked for identification—
Mr. Greer: No objection.

Mr. Rathburn: (Continuing:) —from Mr. Hofer to Mr. Bond.

732 The Court: It may be received.

(Said letter from Mr. Hofer to Mr. Bond, so offered, was received in evidence by the Court and marked Plaintiff's Exhibit 19.)

Mr. Rathburn: I offer in evidence as Plaintiff's Exhibit 20 photostatic prints of the title page and of pages 14 and 15 of the 1938 publication by Mr. Lochhead.

Mr. Rathburn: Q. In connection with this survey you made, Dr. Hofer, how many letters in all did you send out inquiring about this?

A. Well, there was about a dozen.

Q. Did you send a letter to Dr. Fred?

A. I don't believe so.

Q. Did you send one to Dr. Baldwin?

733 A. I did.

Q. Did you get a reply from him?

A. Not a reply to be used in testimony.

Q. I just want to know if you got a reply. Did you get a reply?

A. Yes.

Q. Did you send a letter to Miss McCoy?

A. No.

Q. Did you send a letter to Dr. Wilson, Dr. P. W. Wilson?

A. These people are all at institutions, different institutions, Dr. Baldwin at the University of Wisconsin, that was all in that letter.

Q. Did you write to Dean Burke?

A. No, he is not working in the field any more.

Q. Did you write to F. E. Allison?

A. No.

Q. Do you have a copy of your letter of inquiry?

A. I think so.

Q. May I see it? I believe you stated you were familiar with the literature in this field—

A. I am.

Q. (Continuing:) —in 1938?

734 A. I am.

Q. Have you ever seen the Kroenberger article prior to this trial?

A. Yes, I have.

Q. You are familiar with it?

A. Yes.

Q. In 1938?
A. No.
Q. When did you first become familiar with it?
A. I may have seen a reference to it or seen the article in 1938, but it isn't the kind of article that carries much weight.
Q. You didn't study the article? You couldn't say you knew what was in it at that time?
A. I knew enough about what was in it to form my own opinion of it, which wasn't high.
Q. When were you first engaged in connection with this law suit?
A. Well, about a year ago it first became known that this was coming up.
Q. That was before you ran these tests—
A. Yes.
Q. (Continuing:) —you have put in evidence, the tests on clover?
735 A. Yes.
Q. And were those tests made at the request of the defendant in this case?
A. Well, the tests came about in this way: I asked—
Q. Could you answer that question directly, Doctor?
A. No.
Q. They were not made at the request of the defendant?
A. No.
Q. For whom were they made?
A. I can explain it to you.
Q. All right.
A. I asked my immediate superiors about the matter, whether I should become involved in this. They said they would hesitate to say. They would like to have the director of the Experiment Station give his opinion, and he said, if I participated in this, I should be prepared to present the true facts of the case since there was little evidence available, practically nothing except what I myself had done. I ran this test in as thorough a way as I knew how to get the true facts in the situation.
Q. Did the defendant know you were running the test?
A. Yes.
Q. They financed it?
736 A. No.
Q. They did not finance it?

A. No.

Q. As I understand your test, you got five strains of clover bacteria, five strains of alfalfa bacteria and five strains of soy bean bacteria from Dr. Lochhead?

A. That isn't exactly right.

Q. Five of alfalfa clover and soy beans?

A. That is right.

Q. What did you ask for from Dr. Lochhead?

A. I asked for five effective cultures from each of those groups. In science we have to be awfully careful—

Q. I think you have answered the question. You asked for five effective cultures?

A. Yes.

Q. When you got those cultures, you prepared a mixed culture by growing all fifteen strains together for a period of two weeks?

A. That is right.

Q. At the end of that two weeks, you didn't really know how much of each strain you had in there, did you?

A. I did know.

Q. You could tell one strain of alfalfa from an 737 other strain of alfalfa?

A. No, but I knew how many clover and sweet clover and soybean were in that culture.

Q. How did you know that?

A. I made tests.

Q. That answers my question. You didn't know how many of each strain of clover you had in there?

A. No.

Q. You didn't know how many of each strain of alfalfa?

A. No, but they grew uniformly. If one strain had been inefficient it would have thrown it off.

Q. But you didn't know?

A. Not to any individual strain.

Q. And you didn't know as to how many strains of soy bean?

A. No.

Q. Did I understand you to say you inoculated the soil with this test instead of the seed?

A. Yes.

Q. I believe you also said that was standard practice today, didn't you?

A. In certain ways it is coming to be used.

Q. I am asking did you say that was standard practice?

738 A. Well, there are different purposes for which legume bacteria are used, and I can't say it isn't standard practice and I can't say it is standard practice.

Q. I will rephrase it. Is it standard practice to buy a package of Legume-Aid and inoculate the soil with it for field clover?

A. I recommend it for garden use.

Q. I asked for field use is it standard practice to buy a package only?

A. No, it isn't.

Q. It isn't standard?

A. It isn't standard.

Q. Dr. Hofer, I have got a little bit mixed up during your direct testimony. I can't tell which photographs relate to which of the tabulated data on this sheet.

A. The big photographs.

Q. The photographs show your test results?

A. In the photograph the right hand half of the experiment, the right hand seven rows of pots, all connected to that right hand flask, all those are clover.

Q. Those are all clover?

A. That is right.

Q. Are they all red clover?

739 A. That is right.

Q. All right. Now, which row of pots shown at the right hand side there correspond to the top horizontal column in your report, Defendant's Exhibit 29?

A. The one on the very right.

Q. The row marked '1'?

A. The row 1 in the table corresponds to the row 1 on the bench.

Q. And I assume it is the same as to 2 and 3?

A. That is right.

Q. That corresponds to rows 2 and 3?

A. That is right.

Q. And then row Zero is the control row?

A. That is right.

Q. And row 15 is the one where you used the mixed culture?

A. That is right.

Q. All 15 strains?

A. That is right.

Q. And rows 4 and 5, the 4 looks kind of like a 1, but I think it is a 4—

A. It is a 4.

Q. (Continuing:) —corresponds to the rows 4 and 740 5 on your test tables?

A. That is right.

Q. Did you in arriving at the results shown in test report, Defendant's Exhibit 29, apply any statistical analysis to your result?

A. You mean this table?

Q. This table.

A. No, because—

Q. I just asked if you did.

A. No.

Q. The answer is no. Then you couldn't tell usually—there isn't any standard deviation from the mean then if you didn't apply any statistics?

A. It is simpler this way.

Q. Returning to your photographs again, Doctor, to the one, Defendant's Exhibit 26, it is the one marked A—

A. Oh.

Q. (Continuing:) —what are the pots on the left side of the table?

A. Sweet clover.

Q. Did you make any report on them, any analysis and report?

741 A. No.

Q. You just grew them and didn't do anything with them?

A. I wanted to do something with them.

Q. But you didn't?

A. Insects got in and ruined the experiment.

Q. The photograph, Defendant's Exhibit 27, am I correct in the assumption that the pot at the extreme right with the 2 in front of it is the same pot as is shown in the second row of Defendant's Exhibit 26?

A. That is right.

Q. And in Defendant's Exhibit 28 the pots, I believe you said are the same as in 27 except that the numbers have been removed?

A. The numbers were not removed. The camera was too high to take them.

Q. But they are the same rows appearing in the same order?

A. That is right.

Q. I noticed from your report, Defendant's Exhibit 29, that you have only four control pots in the row, but you have eight pots in each of the other rows. Why was that?

A. May I explain?

Q. Yes, sir.

742 A. Toward the end of this experiment, when the sweet clover began to have insects in it, I spent quite a bit of time trying to keep the insects out of both the sweet clover and the red clover. One hesitates to apply chemicals to an experiment like this and the advice was that the simplest way to control the red spiders was to keep the greenhouse very humid and actually wash the plants with water.

Unfortunately when that was done a few stray bacteria were carried into those four pots and they began to show results that were not typical of the treatment that they had had.

I removed the pots, and shortly after that removed the whole experiment.

743 Q. Are you sure no stray bacteria got into any of the red clover plants?

A. Well, if that would happen it would make very little difference for this reason: The control pots were free of nodules, they were hungry for nitrogen. New bacteria falling on there would immediately work. The other plants were full of nodules of bacteria that were working, and a stray bacteria or two falling in there would have little effect on the hundreds or thousands or perhaps millions already there.

Q. Now, with respect to—

The Court: Q. They are in a better position than the defendant's plants?

A. Yes, they are already overridden by bacteria.

Mr. Rathburn: Q. Now, with respect to the report which you submitted on the comparison of satisfactory garden cultures as compared to other cultures over a number of years—

A. Yes.

Q. —you considered there only whether or not the bacteria were present, did you not?

A. Yes, whether the nodule formation was good so that the plants were in a position to go ahead and

744 develop nitrogen.

Q. You made no test to determine how efficient any of those cultures were?

A. No, except incidentally as we happen to see the plants and notice that they thrive particularly well.

Q. You could not remember now which ones were and which ones were not over this number of years?

A. No, just general impressions is all.

Q. You can't tell us much more than that the bacteria was there.

A. Were viable and active.

Q. Viable enough to form nodules?

A. Viable and active.

Q. Are you familiar with the method of statistical analysis known as the analysis of variance?

A. People get all involved in statistics and I try to design my experiments so that this will not be necessary.

Q. Doctor, please, are you familiar with the statistical analysis method known as the analysis of variance?

A. Not that particular method.

Q. Then when you testified with respect to what effect would be involved if you had only three pots as against five, you were not considering the effect that an
745 analysis by the method of variance might have on the result?

A. I considered these things with statisticians numerous times.

Q. But you are not familiar with the analysis of variance?

A. Personally I have not used that method.

Q. Now, with respect to your report on lima beans from two types of inoculants, Defendant's Exhibit 31, I understood you to say that the lima bean, the single culture inoculant that you used was nitragin.

A. Each year—I think I can give the exact date from my records at Geneva if that is still admissible—but each year I think Nodogen single strain and Nitragin single strain was used in comparison with the mixed culture of each.

Q. You say "with the mixed culture". You mean the mixed culture—

A. Of each of those two companies, using the same strains in the mixed culture as were present in the single culture.

Q. That is what I was going to get around to.
746 How did you know they were the same strains in the single culture and in the mixed?

A. I understand it is not possible to quote anyone in court, so—

Q. You did not know?

A. I did not know from my own experience.

Q. In connection with the field test that you made on mixed cultures and single cultures, garden cultures, they were, I believe, was your field setup approved by a qualified statistician?

A. Why, I did not take it to a statistician by running it, but it was discussed with statisticians previous, and each year I run similar tests in accordance with the advice of statisticians at our station.

Q. How was the setup randomized? Were you careful about that?

A. Absolutely. I made a layout of the plot and marked out the rows and gave each row a number, and then wrote that number on a piece of paper. I took those papers and tossed them up into the air and let them come down where they would, and then took those, beginning on one side of the room, picking up always the nearest one and putting that down, and then the next
747 one, and that is how—excuse me.

Q. We are talking about field tests.

A. Excuse me, that is right. I am talking about the field tests but I did not take the numbers of the pots, I took the treatments to be applied on the pots, and the first treatment, picking up, was put on the first pot, the second on the next pot, and so on clear through the whole field.

Q. In connection with the amount of variation that is encountered in field tests and as compared with greenhouse tests, where you start with sterile sand, isn't it a fact that in the greenhouse tests the amount of variation can be held to a minimum by a skillful operator as compared to an unskillful operator?

A. Well, I don't know what to say about that. We assume that a skillful operator will run the tests or they won't be run.

Q. That is a nice assumption, but assuming that an unskilled operator runs a test in the greenhouse, he will get a much wider variation than a skillful operator?

A. An unskilled operator would probably mess up
748 the whole thing.

Q. Just going back one minute to your tests reported in Defendant's Exhibit 29, that is, the clover tests

again; when did you advise the defendant that you were making these tests?

A. I don't recall.

Q. I don't mean as a matter of date. Was it before you started the tests or after?

A. I think so, I think I told him that I was going to run the tests.

Mr. Greer: May it please your Honor, I would like for the record to show that counsel for the plaintiff requested the witness to produce the letter which he wrote to the scientists requesting their opinion, and that letter has now been produced and shown to counsel for plaintiff.

The Court: All right.

Mr. Rathburn: Will you mark this for identification as Plaintiff's Exhibit 21?

(Letter of Dr. Hofer to scientists requesting their opinion was thereupon marked as Plaintiff's Exhibit No. 21, for identification.)

749 Q. I show you this letter, Dr. Hofer; is that a copy of the letter that you circulated in connection with this survey?

A. Yes.

Mr. Rathburn: I offer in evidence this letter as Plaintiff's Exhibit 21, just identified by the witness.

753 The Court: All right, then Plaintiff's Exhibit 21 is received. Read it so I will know what the question was.

754 Mr. Rathburn: This particular letter is addressed to Dr. Conn, at the New York Agricultural Experiment Station, Geneva, New York. (Reading)

"You may have heard of the lawsuit now pending between two inoculant companies and which is scheduled to go to court in the near future."

I might digress to say the letter is dated May 18, 1945. (Continuing)

"I am told that it will be necessary for me to testify, and since certain questions are involved that deal with problems with which you are familiar, I am wondering whether you would be willing to give me the benefit of your opinions.

"Briefly, the question at issue resolves around certain statements in the patent. One is: 'It has heretofore been considered impracticable to prepare a composite culture inoculant containing organisms

which will cause nodulation on more than one of the cross-inoculation groups. This has not been done
755 because it was generally believed that one species produced an inhibitory effect on another species within the same culture, whereby symbiotic nitrogen fixation by the plant and the organisms was inhibited or even prevented. For this reason it has been considered desirable to use a culture containing a single species of organism rather than on—"

I think that is a misprint and should be "one".

"—containing a mixture.

"Also: 'As has been pointed out above, composite cultures for inoculating the seeds of leguminous plants have not generally come into use because of the inhibitory effect that certain strains of certain species of Rhizobia have on each other.'

"A good deal of the case hinges around this question of inhibition of nitrogen fixation in one group of bacteria over a different group. Because of the importance of this point, I should appreciate knowing whether or not you believe that such an effect
756 actually occurs. The more answers there are to this letter obviously the better will be the measure of scientific opinion on the subject.

"Unless you object, it is my plan, if and when I am called, to include your answer with the evidence.

"Assuring you of my great appreciation for any support you may give me in presenting this matter fairly, I am

Sincerely yours,

A. W. Hofer."

Mr. Rathburn: That is all.

757 Mr. Greer: I offer as Defendant's Exhibit 34, a certified copy of the file wrapper and contents of the Bond patent in suit, No. 2,200,532.

The Court: It may be received.

758 (Said document, so offered and received in evidence, being certified copy of the File Wrapper and Contents in the Matter of the Letters Patent of Varley Sherman Bond, assignor to Kalo Inoculant Company, Number 2,200,532, granted May 14, 1940, for Improvement in Bacterial Inoculants for Leguminous Plants, was thereupon marked as Defendant's Exhibit No. 34.)

759 Mr. Greer: And likewise photostatic copies of page

114 of this book of Fred, Baldwin, and McCoy, and I would like to state that this photostatic copy has some underscoring or notes on the side of it, and I am not trying to say that that underscoring is in the original book. It was on the original pages and has been reproduced in this photostatic copy.

The Court: That is Defendant's Exhibit 35?

Mr. Greer: 35, yes.

The Court: Yes, it may be received.

(Said document, so offered and received in evidence, being photostatic copy of page 114 of book entitled "ROOT NODULE BACTERIA AND LEGUMINOUS PLANTS", by Fred, Baldwin, and McCoy, was thereupon marked as Defendant's Exhibit 35.)

760 Mr. Greer: And also photostatic copy of page 136 of the same publication.

The Court: That will be Exhibit 36. It may be received.

(Said document, so offered and received in evidence, being photostatic copy of page 136 of book entitled "ROOT NODULE BACTERIA AND LEGUMINOUS PLANTS", by Fred, Baldwin, and McCoy, was thereupon received in evidence as Defendant's Exhibit No. 36.)

Mr. Greer: And with that the defendant rests.

Whereupon the defendant rested its case.

761 Mr. Greer: For the sake of the record and so that there can be no confusion about it, with regard to Defendant's Exhibits 5, 6 and 7, which were the Curie reports, I understand you object to them, Mr. Thiess, on which you asked the judge to withhold his ruling until you had the opportunity to put Mr. Curie back on the stand, and you decided not to put him back on the stand.

The Court: They may be received;

(The summary headed: EFFICIENCY OF CLOVER BACTERIA AS AFFECTED BY ALFALFA BACTERIA, dated October 27, 1944, was received in evidence as Defendant's Exhibit 5.)

762 (The photographs (Defendant's Exhibits 6-A to 6-L, inclusive for identification), showing 2 rows of five jars in each row on each photograph, with plants therein, showing heading above top row of: CLOVER, headings in the center between rows as follows: CLOVER BACTERIA 202, 2A1, 2A2, 2A3, 2A4, 2A5, 2A6, 2B1, 2B2, 2B3, and 2B4, and: 12 STRAINS CLOVER BACTERIA, respectively, on said respective photo-

graphs; and the heading below the bottom row of jars on each photograph: PLUS 12 STRAINS ALFALFA BACTERIA, was received in evidence as Defendant's Exhibits Nos. 6-A to 6-L inclusive.)

(The document entitled: THE EFFECT OF ALFALFA NODULE BACTERIA RHIZOBIUM MELILOTI ON THE ACTIVITY OF CLOVER NODULE BACTERIA RHIZOBIUM TRIFOLII, by I. H. Curie was received in evidence as Defendant's Exhibit 7.)

Mr. Rathburn: Before examining our first witness, your Honor, I want to offer in evidence as Plaintiff's
763 Exhibit 22 the translation of the article by Gerlach and Vogel, about which Mr. Bond testified during his testimony on prima facie.

The Court: Plaintiff's Exhibit 22, the translation of the Gerlach and Vogel article, may be received.

(The English translation of article by Prof. Dr. Gerlach and R. Vogel, entitled: OBSERVATIONS ON THE ACTION OF HILTNER'S PURE CULTURES FOR LEGUMES (Report of Kaiser Wilhelm Institute for Agriculture, Bromberg, Germany) was received in evidence as Plaintiff's Exhibit 22.)

764 WHEREUPON THE PLAINTIFF, TO FURTHER MAINTAIN THE ISSUES ON ITS BEHALF, OFFERED AND INTRODUCED THE FOLLOWING EVIDENCE IN REBUTTAL, TO WIT:

WAYNE WILLIAM UMBREIT was called as a witness on behalf of the Plaintiff, and having been first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Rathburn.

Q. Will you please state your full name and your present address?

A. Wayne William Umbreit, 130 University Avenue, Ithaca, New York.

Q. Will you please state your age and your present occupation?

A. Age, 32; occupation: Associate Professor of Bacteriology at New York State College of Agriculture, New York State College of Agriculture, Cornell University, Ithaca, New York.

765 Q. What is your education and research background which qualifies you to testify as an expert in the case involving the questions of root nodule bacteria that are involved in this litigation?

A. Bachelor of Science, Wisconsin, 1934; Master of Science, Wisconsin, 1936; Doctor of Philosophy, Wisconsin, 1939. From the period of 1934 until 1937 I was engaged in research at Wisconsin under Dr. P. W. Wilson on the mechanism and biochemistry of this nitrogen fixation process.

From 1938 on I was engaged in the production of the University's inoculation cultures and did some research on the subject. That extended until July 1, 1944.

In the interim I was wholly at Wisconsin, except for a period of one year, 1937-1938, when I was at the New Jersey Laboratory, with Dr. Waksman.

Q. Since January 1, 1944, is that the date you gave?

A. July 1.

Q. You have been in your present position at Cornell?

A. Yes.

Q. Dr. Umbreit, as you were familiar with it, in 1938, what was the prevailing scientific opinion regarding the use of mixed cultures for legumes?

766 A. Well, as I understand it or understood it at the time, the mixed culture was not very popular; it was not considered a successful culture.

Q. They were on the market at that time?

A. Yes, the garden cultures certainly were on the market.

Q. Why, in your opinion, did this rather discouraging view of mixed cultures prevail?

A. Well, it seems to me that, first of all, people were not too interested in preparing one and the other thing was that the ones that had been prepared had not been very successful. It did not look like a good bet to try it.

Q. In 1938 what is your view of scientific opinion in connection with the existence of inhibitory strains?

A. I doubt whether in 1938— Well, certainly I did not believe in the existence of inhibitory strains in 1938, and I doubt whether other people did.

Q. Why didn't you agree with it in 1938?

A. Well, I never studied the subject. I wasn't interested in it. It never occurred to me that this sort of thing might occur.

Q. I believe you said that you thought that was the prevailing opinion?

A. Yes.

767 Q. How do you explain this when in the literature, —at least, the Kronberger article,—had shown inhibition?

A. Well, I don't think very many people read the Kronberger article. Thousands of papers are published each year on legume bacteriology and one certainly doesn't get to read all of them.

Q. You are familiar with the Kronberger article now?

A. Yes.

Q. In your opinion does the Kronberger article point to the existence of inhibition?

A. Yes, in my opinion it does.

Q. After the appearance of the Bond patent and UNICULTURE on the market, was there any scientific work done at the universities with which you are familiar on the problem of inhibition?

A. Not that I know of.

768 Q. Why do you think that no work was done?

A. Well, that was along about the time the war was beginning to hit us and we didn't have time or facilities to do it. I think that in the future it will probably be studied quite intensively.

Q. In your opinion do inhibitory strains of legume bacteria exist?

A. I believe so.

Q. On what basis do you form that belief?

A. Well, first Kronberger has demonstrated that by mixing cultures such inhibition is obtained. So far as one is able to tell, that is the sole difference,—the strains which are having fixation and the ones that are showing this inhibition,—is the ones that show the inhibition have been mixed together.

Then there is, as there have been introduced in this trial, some further earlier reports which would indicate that, though I wouldn't be able to prove it, and then there is the work of Mr. Bond which shows exactly the same thing, that if you mix these cultures, which is the sole difference between them, this inhibition is obtained.

Now, I wouldn't see how you could avoid, whether you like it or not, however you interpret that, the con-

769 clusion that there are inhibitory strains.

Q. Do you know if there is any evidence that inhibitory strains do not exist?

A. No, I do not.

Q. Do you believe that non-inhibitory strains do exist?

A. Oh, yes, I am quite certain of that. There certainly has been plenty of evidence introduced into this trial that noninhibitory strains exist. Certainly the experiments of Dr. Erdman show that when some strains are used, no inhibition is obtained.

Dr. Hofer's show the same thing; those of Mr. Curie, although there is very considerable variation occurring in them, probably show the same thing.

The Court: You said noninhibitory strains?

The Witness: It is my conviction both exist.

The Court: The latter must be true or else the product isnt any good?

The Witness: I don't think there is any question about it.

The Court: I am talking about both sides.

The Witness: That is right.

Q. (By Mr. Rathburn) The validity of the experiments on which you base your conclusion as to inhibitory
770 strains has been questioned. What do you have to say about that?

A. Well, I think we could take up first the Kronberger experiments. They have been criticized as not showing that inhibitory strains existed, on the ground that the techniques were not standard.

There were three reasons that the technique was not standard. One was that soil humus mixture was used which is not the sort of thing we use for testing this thing now. But it seems to me the point is that this was used constantly in all of the pots and that still there were differences between these pots.

Now the sole difference that we can put our finger on is that in one case the things were mixed together and in the other case they weren't.

The next one was that the soil was not sterilized. Well, there were controls in these experiments and then the addition of bacteria caused an increase.

The third thing—

Q. Sterilization of the seed—

A. —oh, yes, the sterilization of the seed was too vigorous. The only thing one can say is the plants grew and were able to fix nitrogen.

Now while that is a very drastic treatment, that would be more or less in opposition to what Kronberger
771 wanted to show, or at least was showing in his paper;

you would think that if you had some harm there it would reflect on the growth of his plants or their ability to fix nitrogen and that apparently wasn't the case.

Furthermore, more drastic treatments of seed sterilization have been used in the field. It is a drastic one but not too drastic. The evidence is that the plants grew and fixed nitrogen.

Q. Then I take it that you believe these experiments in the Kronberger article are valid?

A. I believe they are valid.

Q. Do you know, aside from anything that has been introduced in this case, of any other reasons why these experiments of both Kronberger and Bond should not be accepted?

A. No, I do not.

Q. I call your attention to a chart which is in evidence as Defendant's Exhibit 8, Dr. Umbreit; have you examined that chart (handing document to the witness)?

A. Yes.

Q. On the basis of what is shown in Series 2 and 4, would you conclude that there was inhibition?

A. Yes, in this experiment I would conclude that there is inhibition. The things that you have to compare, 772 here, as you pointed out, are 2 and 4.

The sole difference between them is 4 was mixed with alfalfa. Otherwise, this whole set-up is the same.

Now the total variations have been plotted here and these two are different. Some inhibitory effect has been caused by this mixing. The total range is plotted here and these do not come from what a statistician would call the same population.

That is, these are two distinct differences, that this difference, in spite of the variation is real, that these come from two different kinds of things.

Q. Have you had any experience, Doctor Umbreit, in attempting to evaluate greenhouse tests for nitrogen content by visual observation?

A. Yes.

Q. What do you think about visual observation as a test?

A. Well, if you don't have anything else you can use it. It is not very accurate. The 20% or 30% or 15%, that has been brought out in the trial,—we will say 15% will be reasonably good, but every once in a while you can get terrifically fooled on them because of bunch-

ing and because of greenness and other variations which your eye doesn't take in.

773 Q. Would you accept the conclusions of a scientist as to nitrogen fixation who had made nothing except visual observations if he was within 25%?

A. No. You simply can't tell that. If his differences are big, that is another thing.

Q. You have been present in the court since the start of the trial, have you?

A. Yes.

Q. As you may recall, Mr. Curie testified that in some measurements with respect to their LEGUME-AID he had found a growth or an increase of about 40 times over the 5-day period in which the mixture was allowed to stand before packaging.

I think he said he couldn't be very accurate about it but he did have one which was 40 times. What would you say as to that with respect to whether it was a normal growth or a retarded growth of root nodule bacteria in that length of time?

A. Well, 40 times is not very large. You see, we are dealing with numbers that are up in the billions in the first place and our methods of measuring things that large are not too good, and a difference of 100 or 1000 times we would place some question on. As a matter of

774 fact, if the difference were 100 times with populations that large we would say: Well, maybe these are different but not very much.

Mr. Rathburn: That is all.

Cross-examination by Mr. Greer.

Q. All right; just a question or two, Dr. Umbreit. As I understand you, you believe now that there is a strain of this Rhizobium bacteria that is inhibitive when associated with another strain, and there are other strains which are not inhibitive.

Am I correct in that being your opinion?

A. That is right.

Q. Now this question of inhibition or lack of inhibition is a work of nature, as I understand it, is it not?

A. As far as my opinion would go that is absolutely so.

Q. I didn't understand.

A. As far as my opinion would go that is absolutely so.

Q. Well, that is what I am asking for, just your opinion.

A. Yes.

Q. You know of nothing that the man does that brings about this state of inhibition or lack of inhibition, in other words?

775 A. That is right.

Q. You are familiar with the Bond patent, are you not?

A. I am.

Q. Is there anything in that Bond patent, in your opinion, that shows how to prevent inhibition or how to bring on inhibition?

A. With an inhibitive strain there is nothing in the patent that I know of which tells how to prevent that inhibitive strain from inhibiting. But it does tell you also that noninhibitive strains exist and if you use these, you will not have this difference. That is the way I interpret it.

Q. Assuming the fact that there was a non-inhibitive strain, it wouldn't take anybody else's teaching to leave one skilled in this art know that if there was an inhibitive strain, it was going to inhibit something, isn't that right?

A. Yes.

Q. Now, just one more question on this chart, Defendant's Exhibit 8. As I understood your direct examination you took the comparison between the chart which is Number 2, the showing under the heading Number 2 and Number 4?

A. Yes.

776 Q. According to that chart, just looking at the chart, not taking in your statistical analysis or anything of that kind, that does show a variance, doesn't it, between those two?

A. Yes.

Q. And Number 2 is an inoculation of a leguminous plant with a single inoculant, as I understand it, and Number 4 is an inoculation of a leguminous plant with a mixed culture?

A. Yes, sir.

Q. Now, what would be your opinion as to a possibility that there might be that same variance if you were using a single inoculant in Number 2 and the same single inoculant in Number 4? Is there a possibility of that same variance showing up?

A. You mean in a different experiment?

Q. Yes, I mean in a different experiment.
A. That you can't tell. You have no knowledge of that.
Q. I am asking your opinion as to the possibility?
A. Yes.
Mr. Greer: No further cross-examination.

777 *Redirect Examination by Mr. Rathburn.*

Q. In the same experiment with the same strain of single culture, would you expect a difference like that to show up, Dr. Umbreit?
A. No. The thing is my interpretation of both answers would be that if you had a difference which showed that these two came from two populations there was something different about those two populations, whether you knew what it was or not.
Mr. Rathburn: That is all.
Mr. Greer: Nothing further.
(Witness excused.)

ROBERT H. BURRIS was called as a witness on behalf of the Plaintiff, and being first duly sworn, was examined and testified as follows:

Direct Examination by Mr. Thiess.

Q. Will you please state your name, residence, and present occupation?
A. Robert H. Burris, University of Wisconsin, 778 Madison, Wisconsin; Assistant Professor in Biochemistry.
The Court: Did he ask you to state your age?
The Witness: 31.
Q. (By Mr. Thiess) Dr. Burris, what training have you had which would qualify you to testify as an expert in a case involving legumes and the inoculation of legumes by bacteria, as set forth in the patent in suit?
A. I received my Bachelor's degree from South Dakota State College in 1936. During the years of 1935 and 1936 as an undergraduate, I worked in the South Dakota Experiment Station Chemistry Laboratory.
In the summer of 1935 I worked in the Agricultural Bacteriology Department, at the University of Wisconsin; from 1936 to 1940 I was Research Assistant in the De-

partment of Agricultural Bacteriology at the University of Wisconsin; I received an M.S. in Ag. Bacteriology in 1938 and Ph.D. in 1940. 1940-1941, National Research Council Fellow with Professor Harold Urey, Columbia University, New York City. 1941-1944, Instructor in Ag. Bacteriology, University of Wisconsin; July 1, 1944 to
779 the present, Assistant Professor Biochemistry, University of Wisconsin.

Q. Now, Dr. Burris, as a plant biochemist, do you believe that you can estimate the nitrogen content of a plant to an accuracy of 10%?

A. By appearance, that is?

Q. Yes.

A. No; that is quite outside the range of a reasonable expectation for accuracy merely by visual appearance. I would place a more reasonable level at 20% to 25% with the possibility that under certain nutrient deficiencies you might be out of line even to the extent of 33% to 35%.

Q. Why do you answer this in this manner?

A. It is very difficult to have,—to judge a plant merely on the basis of its size. If your plant is bunched up or one is stalky and one is spindly, that throws you off in your estimate.

If you try to judge on the basis of color you find that perhaps the most frequent deficiency, sometimes, in plants is the chlorosis, that, is a yellowing.

Not only does nitrogen give you this chlorosis but many other nutrient deficiencies give you this result so it is quite impossible to estimate with any great
780 accuracy, although you can make a rough estimate.

Q. What do you consider a valid method to determine the nitrogen fixing ability of Rhizobia, single, and in mixtures?

A. The only valid method I could think of at the present time would be to take your seeds, sterilize them, that is, surface sterilize by aseptic procedure, plant them in sterile sand, that is, low nitrogen substrate, inoculate the seeds, grow the seeds, harvest the entire plant, and submit them to a Kjeldahl chemical examination, so that you have the actual chemical analysis of the nitrogen content and include in this proper uninoculated controls so that you know the validity of your experiment at the end, to indicate whether you had any stray con-

tamination and your controls should be subtracted from your other data in your calculation.

Q. And in such an experiment would you analyze only the tops of the plant?

A. That might be misleading. It would give you a general picture of the situation but the top-root ratio in plants is influenced by a number of factors and although, as I say, you would get a general indication of results, I would not consider that a desirable type of experiment.

781 Q. And what have you to say regarding a practice of discarding controls in an experiment of this character?

A. I am afraid that that would have to rank as rank heresy in experimental work.

Q. (By Mr. Thiess) Have you examined the data submitted by Mr. Curie in support of his contention that inhibitive strains of Rhizobia do not exist?

A. I have looked over that data.

Q. And what is your opinion of Mr. Curie's data?

A. Well, in looking over the data you find a variation between replicates as great as 12 fold. Any such variation as that scattered through the data would make you very suspicious of drawing any conclusions from it.

782 Q. Have you had any training in the use of statistical methods?

A. Yes, I did take a course in statistics from Dr. Churchill Eisenhart of the University of Wisconsin.

Q. What would you say constituted a valid statistical test of plant experiments such as have been under discussion in this litigation?

A. You can make a valid analysis by determining the standard deviation of your results and comparing the standard deviation between your samples you wish to compare, and see whether your two populations overlap.

You can interpret your results to find out at what level these results may be significant, whether they are significant three times out of four, or whether they are significant 19 times out of 20. The distinction, of course, results.

A more rigid statistical analysis is an analysis of variants such as introduced by Dr. Fisher some 20 years ago and has been developed since. That is a more rigid test than merely a determination of your standard deviation.

Q. Now, being qualified by your previous training,—
if you were qualified, I will put it, by your previous
783 training to produce legume inoculant commercially,
would you, if you were in such a business, rely upon
visual tests for estimation of nitrogen fixation of the
strains of Rhizobia you employed?

A. No, I would certainly employ an analysis involving actual chemical nitrogen analysis. The purported difficulties of such analysis are not so great. It is really very routine and simple procedure, unless you have 10,000 plants to analyze, in which case it would involve considerable time.

But that is the most valid estimate of your nitrogen fixing ability and the method is valid to 1% to 2%, which is about at least ten times as accurate, more than ten times,—probably twenty times as accurate as your visual analysis and hence I think it definitely would be adopted.

Q. Have you ever encountered any data in the literature indicating that mixed garden cultures have been tested for their efficiency in nitrogen fixation in comparison with the single constituent strains?

A. I have never encountered any published data indicating that mixed garden cultures have been tested against single constituent strains for their nitrogen fixing
ability. The only thing you have published on garden
784 cultures are the various tests from the State Agri-
cultural Stations and the Ag. Markets Department, indicating plus or minus nodules and sometimes, occasionally visual tests to say successful or unsuccessful in relation to the efficiency of the strain, but no actual analysis, although I think this afternoon perhaps some very late ones, unpublished work has been introduced.

Q. What is your recollection of the opinion in the art prior to the Bond patent regarding the cause of the general failure of mixed legume inoculants?

A. That is a very difficult question to project one's self back to 1936 or 1937. At that time I was at the University of Wisconsin which has been a center of work in this nitrogen fixation field and I must say that there was practically no discussion of the matter.

Nobody was greatly interested in it. They thought,—it was the general opinion that mixed cultures were unsuccessful. That had been the experience. There had been several on the market. They had gone off the market merely because they were unsuccessful.

Nobody was particularly interested in it. They were opposed to mixed cultures but they didn't bother themselves much with determining why these unsuccessful
785 results had accumulated.

And their disinterest was probably reflected in the fact that they didn't even bother to look up in the literature about this specific problem to say nothing of actually running tests themselves to back them up.

We just can't find much data in the literature on it. Nobody was particularly interested in it or worried about it. I think to actually say what the opinion was at that time would be a most difficult thing.

The Court: You mean speaking generally?

The Witness: Yes.

The Court: You have told him what it was in Wisconsin.

A. (continued) They knew mixed cultures were unsuccessful. They were dead set against them and I think that was the general opinion but the source of that difficulty no one was very much concerned with. They had more or less thrown mixed cultures out the window and weren't bothering themselves much about it because of inefficiency.

Q. (By Mr. Thiess) Now, Dr. Burris, do you believe that the statement by the patentee in the patent in suit that: "It was generally believed that one species produced an inhibitory effect upon another species within the same culture whereby symbiotic nitrogen fixation
786 by the plant and the organism was inhibited or even prevented", was an unwarranted statement?

A. No; I think it would be very difficult to say that was an unwarranted statement. As I said, most people hadn't looked into the literature. Now, in retrospect, when we do look over the old literature, we find there was very little existent and that which is existent, the best data suggests that an inhibition might occur, so I think it was perfectly logical in reading the literature and evaluating it and taking the conclusions of authors such as Kronberger, that Mr. Bond could have come to the conclusion that that was the general opinion.

Q. Do you consider that the Kronberger experiments were performed by valid methods?

A. Yes, I can't see any particular objections to them.

Q. Now, what is your opinion as to how long soil will have to be treated in an autoclave to properly sterilize it?

A. Well, the Rhizobia, of course, are very sensitive to heat and this experiment as it was stated, was interested in the root nodule bacteria Rhizobia, and holding them for ten to 15 minutes at 53 degrees or 54 degrees Centigrade will kill them off, if they are in water
787 suspension. If they are in soil it would obviously take more rugged treatment than that.

But I would say that the 121.8 degrees Centigrade that you get at 15 pounds steam pressure would, most assuredly, kill them off in 15 to 20 minutes in a pot of soil such as Mr. Kronberger used.

There was not a very large pot that he used, one with 2 1/2 kilograms of sand and one kilogram of this humus material. I think you would anticipate that Rhizobia would be killed off in well less than 15 or 20 minutes.

That certainly would assure there being killed off since the rate at which they are killed goes up very rapidly with an increase of temperatures; that is, a 10 degree rise in temperature doubles the rate of rise at which you would kill off the organisms, since they are sensitive at low temperatures.

Q. Does that increase geometrically as you go on up the scale?

A. Not quite geometrically but there is a rather more rapid increase than you might expect in the killing rate.

Q. Do you consider the sand humus soil used by Kronberger as objectionable?

A. Kronberger was using quartz sand and proba-
788 bly with treating the soils, he thought: Well, quartz . . . sand like that didn't quite simulate the soil,—he wanted to get in a few of what the soils-man would call base exchange compounds, that is, the plant nutrition; the plant gets its nutrients by the process known as base exchange.

That is, the plant gives off hydrogen ions from the roots in exchange for calcium and magnesium ions, an exchange very comparable to the exchange of sodium and magnesium in a zeolite water softener.

And he probably put in some colloidal material to give him some base exchange compounds. In putting in this humus he would introduce nitrogen. He didn't have such low nitrogen substrate as is used in many experiments but the key thing to keep in mind is that Kronberger included uninoculated controls and at least gave his results for the uninoculated controls, and his inocu-

lated plants showed a stimulation over that, so that the soil factor was taken into consideration by his control plants.

Q. Now, would you say that the soil that Mr. Kronberger used was more objectionable than the soil used by Dr. Manns, referred to in his Bulletin and in his patent?

A. Well, since he used in the Manns experiment,—
if you examine the data you find he used 8,000 grams
789 of a straight compost in which he plants, and this being in his favor as being rich in nitrogen, I would say it was not certainly not more objectionable in the case of Kronberger than in the case of Manns, with respect to the soils used.

Q. And you refer to these 8,000 grams of humus. Why would you say that was objectionable?

A. Well, it contains a very large amount of nitrogenous nutrients, and if you examine the data you find numerous instances where the data are reported: No nodules, excellent growth.

And the only conclusion is that the plants were getting the nitrogen nutrition under such condition from the soil substrate and not from the air.

Q. And can you tell the court why Kronberger added soil to his sand?

A. Well, as I pointed out before he probably wanted to add some base exchange materials and to more closely simulate soil conditions.

Some people have a little objection to using a straight quartz sand for their experiments although it can be used quite successfully.

Q. In your opinion would 1% mercuric chloride be
injurious to the seeds employed in this test?

790 A. No; I don't see where that has any valid, that is, particularly valid objectionableness, because the plants germinated, the bacteria infected the plants and formed root nodules, nitrogen was fixed, and again we have the controls there to take care of the matter, and as for 1% mercuric chloride being particularly a vigorous treatment many of these leguminous seeds, the small seeds especially, have very tough coats and certain of them, before they can germinate, have to be scarified by a treatment of an hour or two in concentrated sulphuric acid, so they have a very tough seed coat, and the acid can be washed off quite readily with sterile water.

Q. Do you believe that that,—that Mr. Kronberger's conclusions that the antagonism of the Rhizobia in the mixture in regard to their nitrogen fixing ability is a reasonable one?

A. I think it is perfectly reasonable, but it may indicate that when he mixed the strains together he got less fixation than when he used them singly, and he had adequate controls in his experiment.

In his conclusions he surveys the possibilities and he suggests that maybe it was just a lack of sufficient growth by the organisms, but he does away with that argu-
791 ment that he raises to himself, and comes to the conclusion that his data indicate inhibition and I think he has a valid point.

Q. Do you know of any other data indicating that inhibitory strains of Rhizobia exist?

A. There really isn't very much data in the literature indicating that. There is the data in the patent and in the testimony; more data has been introduced by Mr. Bond, and the defendant has introduced the case of Mr. Currie's experiment in which they state statistical analysis indicates a valid case of inhibition there.

So I would say that the literature is scanty but there are indications that inhibitory strains do exist.

Q. Do you know of any published data to indicate that strains of Rhizobia mutually inhibitory with regard to their nitrogen fixing ability do not exist?

A. No, I know of no published data in the literature indicating that inhibitory strains do not exist. I don't think that any published data has been introduced. All that has been introduced is material that has been accumulated since the start of this litigation and as yet unpublished in any journal.

Q. Do you believe that the data in the Bond
792 patent are indicative of the existence of mutual inhibition of the nitrogen fixing ability of Rhizobia of different cross-inoculation groups?

A. Yes, I think that is the only logical way to interpret the data. He set up the experiment in which he has set up a single strain alone and then combined that strain with a strain of organisms from another cross-inoculation group, the only variation being the addition of this other strain of organisms, and he has observed a depreciation in the growth of nitrogen fixation which is statistically valid and I think the conclusion is perfectly logical that this depreciation can be attributed to

an inhibition of the nitrogen fixing ability of the organisms in association.

Q. Now in your opinion as a man skilled in the art, is there any reason to suppose that the existence of an inhibition as described in the patent would be scientifically illogical?

A. No, I think that it is quite logical that you could have inhibition between these strains of Rhizobia. There are many cases of antagonisms between micro-organisms, say, for example, the case of penicillin and that is a mold, of course, but among the bacteria you have-
793 Bacillus brevis, which gives you gramacidin and which is a powerful antibiotic.

Inhibitions between micro-organisms are regularly observed in the art. Certain strains seem to have no effect on each other and, in addition, you will find strains growing in association which will stimulate each other. One may form vitamins and pass it on to the other and stimulate it.

There are mutual interactions like that. To assume that all these Rhizobia either are perfectly innocuous to each other or that they all stimulate each other mutually, would be a rather untenable position.

To say that a mutual interaction in the other direction cannot exist I would say would be a very illogical position.

Mr. Thiess: That is all.

Mr. Greer: No cross-examination.

(Witness excused.)

VARLEY SHERMAN BOND being previously sworn, was called as a witness on behalf of the plaintiff on rebuttal, and testified further as follows:

Direct Examination by Mr. Thiess.

794 Q. Mr. Bond, since you were on the stand on your direct examination in chief, this chart, Defendant's Exhibit 8, has been introduced in evidence.

Will you please discuss that chart and state whether or not that chart properly interprets the data in your patent and whether it does or does not show inhibition?

A. The defendant has altered the columns,—the hypothetical columns representing the nitrogen fixed per 10

plants of clover, in the case of the No. 3 Selected Strain.

There is no logical reason to assume that an average of Strain 2, which is not significantly different than the average of Strain Number 3, could be transferred from one series to another in this fashion.

According to the standard deviation there are no real differences between the columns in 2 and the columns under Number 3 and no competent statistician would pay any attention to this apparent difference.

There is no validity whatsoever for putting the green columns in this chart.

That also applies to the portion under Number 5. Even if there were a real difference between the two, that is even if the average of Number 2 was significantly different than Number 3, there would be no possible
795 excuse for mixing these two unrelated tests. The clover strains used under Series 2 were entirely different strains than those used under Series 3.

Just reviewing the chart, there is obviously a significant difference between Numbers 2 and 4, both of which contain the same clover strains, except in the case of 4 it was mixed with alfalfa.

And likewise there is no significant difference between Series 3 and Series 5, which both contain the second series of clover strains. In Number 3 the strain was tested alone and in Number 5 it was tested with other strains and there was no significant reduction in yield due to this mixture or association of the other strains with the clover.

Q. Now, Mr. Bond, I would like to discuss with you the prior art which has been introduced in evidence by the defendant and upon which they rely.

Have you read these various patents upon which they rely and are you familiar with them?

A. Yes, I am.

Q. I now direct your attention to the George Herbert Earp-Thomas Patent, Number 865,965, and I wish to ask you if a plurality of different species of root nodule
796 bacteria were grown together to form a composite culture by methods described in lines 57 to 100 of page 3 of this patent, would it be possible to predict whether or not the final culture would contain a sufficient number of bacteria of each species to inoculate each of the cross-inoculation groups for which the mixed culture purports to be effective?

A. It would be impossible to insure having each species there in sufficient numbers after a reasonable period of storage so that they would thoroughly inoculate the roots of the respective host plants to which they may be applied.

Q. And why do you say that it would be impossible?

A. There is variation in the rate of growth of the different strains of bacteria, and when they are grown together for a long period of time on the same jelly slant which was used in this case, one or more of the strains may over-grow the others and eventually there would not be a sufficient number of slower-growing strains in that culture after it had been on the dealer's shelf for a time.

Q. At lines 85 to 110 on page 1 of the patent, the patent indicates "that there is only one species of root nodule bacteria and that such bacteria are modified
797 by the food of the plant by which they live so as gradually to become adapted to a new host plant". Is this statement in accordance with present knowledge and accepted scientific opinion?

A. There is no proof that the characteristics of the bacteria in respect to infection of different cross-inoculation groups may be effected by the food upon which they live.

Q. What is the present opinion and on what do you base that?

A. The present opinion is that one specific organism will only inoculate its specific host plant, cross-inoculation group.

Q. There are a certain number,—6 cross-inoculation groups?

A. Yes. There are more than that. There are six important groups, commercially.

Q. Now, referring you to lines 88-93 of page 2 of this Earp-Thomas patent, the patentee there indicates that root nodule bacteria growing and multiplying on host plants in accordance with his method, have greater viability and attain greater virulence than the bacteria living upon the plant in the ground. Is this state-
798 ment in accordance with present knowledge and accepted scientific opinion?

A. No, there is nothing to support this statement in the present scientific literature.

Q. In lines 8 to 21 of page 3 of the patent it is indicated: "That bacteria may be observed through the

test tube to work on the plant". Is this statement in accordance with present knowledge and accepted scientific opinion?

A. It would be impossible to observe microscopic bacteria through the walls of a test tube on the roots of plants buried in jelly within that test tube.

The objective of a high-powered microscope must be closer to the object being examined. The thickness of the walls would preclude an examination of what these tiny bacteria are doing.

Q. In the same portion of the patent the patentee indicates: "That bacteria which enter the roots but that do not form nodules may aid the plant without any external evidence of their presence being visible."

Is this statement in accordance with present knowledge and scientific opinion?

A. This statement is not in accordance with present knowledge and scientific opinion. It is necessary for
799 the bacteria to affect the root and form nodules before they may benefit the plant.

Q. In lines 91 to 100, on page 3 of this patent, the patentee indicates: "That too many root nodule bacteria may injure the germinating plant".

Is this statement in accordance with present knowledge and accepted scientific opinion?

A. No; the patentee claims the root nodule bacteria actually ate out the contents of pea seeds. The root nodule bacteria are incapable of digesting the materials contained within a pea husk. There is nothing to substantiate this statement.

800 Q. May I now call your attention, Mr. Bond, to the statement occurring at lines 6 to 18, on page 2 of the patent, which reads as follows:

> "Owing to this necessity for employing the proper kind of bacteria for each kind of plant, it has been necessary to maintain many different kinds of stock cultures in the laboratory each containing bacteria adapted for a particular plant. Also it has been necessary first to ascertain from a purchaser, the kind of plant which he intended to inoculate before his order could be filled. And as it is necessary to make up the cultures in distributing packages prior to the opening of the season for which they are to be used, so that orders may be filled without delay, it has been necessary to make a supply of distributing packages of each kind of bacteria."

Do you agree with that statement?

A. The statement is essentially true. There are details in it such as:

"Also it has been necessary first to ascertain from a purchaser, the kind of plant which he in-
801 tended to inoculate."

Of course, none of the commercial inoculant companies find it necessary to check up with their customers to see what they are going to buy, but essentially the statement is true.

Q. Now, does this portion of the specification of this patent which I have just quoted to you recognize the advantages of a composite culture?

A. That portion that has just been quoted recognizes the disadvantage of the single cultures.

Q. But made from the composite culture disclosed in this U.S. Patent?

A. In my opinion commercial products so prepared in accordance with the specification of this patent would not be uniformly satisfactory.

Q. On what do you base that opinion?

A. There are tests in the literature showing the unsatisfactory nature of Earp-Thomas composite Farmogerm culture.

Q. Does this patent teach you how to make a satisfactory composite culture containing only clover and alfalfa?

A. No.

802 Q. Does this patent, in your opinion, contain any teaching which would assist one skilled in the art to produce a successful mixed culture for leguminous plants for field work as distinguished from a single culture?

A. No.

Q. Now, I wish you would direct your attention to Earp-Thomas Patent No. 1,099,121, and will you please state generally what this patent discloses?

A. This patent merely discloses the introduction of the concept of the soil culture to be applied to field—to the soil of the field and not to the seed. It is prepared in accordance to the cultures previously described in the Earp-Thomas patent which we just discussed.

Q. 865,965?

A. Yes.

Q. Does that complete your answer, Mr. Bond?

A. Yes, there is nothing else in this patent, that is essentially for soil culture.

Q. Does this patent contain any teachings which would assist one skilled in the art to produce a successful mixed culture for leguminous plants as distinguished from a single culture?

803 A. No.

Q. Will you now direct your attention to the Bottomley Patent No. 1,106,275? Will you kindly state what bearing, if any, the teachings of this patent have with respect to legume inoculants?

A. This patent is a treatment, as the title indicates, a treatment of peat for manurial and other purposes. It has nothing to do with seed inoculation. It is a mixture of three nitrogen fixing bacteria and root nodule bacteria.

Q. What does this patent disclose, rather generally?

A. It is a fertilizer for manure.

Q. Does this patent contain any teachings which would assist one skilled in the art to produce a successful mixed culture for leguminous plants as distinguished from a single culture for field use?

A. No.

Q. Will you now direct your attention to the Earp-Thomas Patent 1,252,322? To what does this patent relate?

A. This patent relates to humus material containing several different types of bacteria and the culture is coated with material which is alleged to protect the 804 bacteria from the harmful effects of fertilizers.

Q. And does this patent say anything about the use of this product in combination with chemical fertilizers, and I refer you particularly to page 1, lines 95 to 99?

A. Yes, these lines refer to the coating of the culture to protect the bacteria in the culture from the effect of fertilizers and other materials with which the culture was intended to be mixed.

Q. Now, in your opinion, does this patent contain any teachings which would assist one skilled in the art to produce a successful mixed culture for leguminous plants as distinguished from a single culture for field use?

A. No.

Q. I now ask you to take up the Earp-Thomas Patent No. 1,309,723, and generally what does this patent disclose and what is it directed to?

A. This patent is essentially a fertilizer containing phosphate rock. The patentee claims that the different types of bacteria present in this fertilizer will reduce the raw phosphate rock to soluble form and therefore make it available to the plant.

Q. Is that statement in accordance with present scientific opinion?

805 A. Most bacteria are very ineffective for reducing phosphate rock to soluble form and the root nodule bacteria in particular would have no effect whatsoever on the phosphate rock.

Q. In your opinion as a man skilled in the art, does this patent contain any teachings which would assist one skilled in the art to produce a successful mixed culture—

A. No, sir.

Q. (Continuing:)— for leguminous plants as distinguished from a single culture?

A. No.

Q. I now want to refer you to the last prior art patent that the defendant is relying on, namely, the Thomas Franklin Manns Patent No. 1,320,701. Can you just give first a general statement as to what this patent purports to disclose?

A. This patent purports to disclose actually two products, the first product— both of which are prepared from peat humus. The first product is claimed to be a bacteria compost for a rich compost containing all the known beneficial soil bacteria.

The second product is a reinforced inoculated or
806 bacterized peat.

The first product is prepared by mixing peat, phosphate, lime, slag, wood ashes, dried blood and molasses and well inoculated soil, moistening the mixture and composting it aerobically for two weeks. The well inoculated soil used to inoculate the mixture is a mixture of soil proven to contain Azotobacter, nitrofying, cellulose destroying, ammoniafying and legume bacteria.

Q. Now, this first product is referred to at page 1, line 41, is it?

A. That is correct.

Q. And the second product at page 3, line 49?

A. That is right.

Q. Now, referring to this first product, are the bacteria contained in a base having a low nutrient value?

The Witness: No, the author states on page 1, line 1[illegible]

"I have discovered that peat, muck, manure, weed compost or other organic material can be trans-
807 formed into a fertilizer containing an accumulation of nitrate nitrogen by bacterial action and a humus content having a high stimulative influence on plant life and possessing great value as a plant food, a soil improver and fertilizer, by reinforcing or adding to the organic matter, phosphorous in the form of basic slag,"

and several other mineral and organic materials. The latter part of my statement is not a quotation from the patent.

Q. I now direct your attention to that portion of the patent on page 2 contained in lines 65 to 96, and ask you whether you agree with the statement insofar as it relates to the grouping of root nodule bacteria into six main cross-inoculation groups?

A. In general the statement is correct.

Q. And is there anything in the Manns Patent and particularly in the excerpt which I have just referred you to that indicates any recognition by the patentee as to the possibilities of inhibition?

A. No, there is no indication of the possibility or existence of inhibition. In fact there is no indication
808 of the recognition that different strains of root nodule bacteria might even vary in their efficiency with respect to fixing nitrogen.

Q. And is there any indication that the patentee does not appreciate the possibility of inhibition, and I refer you particularly to page 2 of the patent, lines 66 to 69.

A. No, the patentee uses well inoculated soil upon which is grown the particular legume for which the inoculation is introduced. A well inoculated soil taken from a field may have hundreds of different strains in it, some of them good strains, some of them fair strains and some of them poor strains, and there would be no way of knowing how efficient or how effective strains from soil dug out of a field might be.

Q. Now, without going into too much detail, can you explain briefly how the patentee proposed to prepare his compost containing all of the beneficial soil bacteria?

A. Well, the compost is prepared in accordance with the mixture indicated on page 2, starting at line 18. This mixture is moistened, stirred and allowed to incubate

for a period of approximately two weeks, I believe
809 it is stated.

The product is examined from time to time, and when the bacteria has reached a certain growth, the patentee concluded the product was ready for use.

Q. In preparing this so-called bacterial compost, does the patentee initially add a large number of each type of bacteria to it?

A. No, the addition of 25 pounds of a mixture of well inoculated soil containing all of these—containing bacteria for all of these cross-inoculation groups—

I am sorry I didn't follow it. I have forgotten what I am talking about. Will you state the question, please?

Mr. Thiess: Will you read it, please?

(The record as above recorded was read by the reporter.)

The Witness: (Continuing:)—adding 25 pounds of well inoculated soil containing bacteria for all the cross-inoculation groups would scarcely be adding a sufficient number of each of these different species to thoroughly inoculate the seeds without additional growth in the compost, and when this additional growth takes place there is no certainty that one specie will not over-
810 grow another.

There is no way to be sure that when you depend upon the growth of the bacteria in this compost that there will be sufficient numbers of any one of all the six groups to thoroughly inoculate the seed for which the product is recommended.

Mr. Thiess: Q. Then, as I understand you, this patentee depends upon the growth of the different species of bacteria in the compost to get the desired number of bacteria of each species in the final product, is that correct?

A. That is correct.

Q. Now, on page 2 of this patent, line 115, the patentee states that such inoculated compost is "allowed to undergo aerobic composting for two weeks to three months," which means he allows the organisms to grow in the moistened mix for that period of time, is that correct?

A. That is correct.

Q. Now, do you know whether bacteria compost of the type disclosed in the patent were eve used commercially?

811 A. The compost so prepared in accordance with all Dr. Manns' testimony was used to prepare Alphano inoculant.

Q. Now, are you familiar with any tests that have been made on the bacterial compost disclosed in the Manns Patent, and I refer you particularly to Bulletin 115, which has been introduced as Defendant's Exhibit 16.

A. Yes, I am.

Q. And have you studied and analyzed the test results reported in this bulletin?

A. Yes, I have.

Q. Can you classify these tests into two different groups?

A. Yes. The first portion of the bulletin is devoted to tests with composts in 4-gallon pots. There is a second portion in which a sterilized sand experiment was conducted and the plants were grown in sterilized sand to which some type of an inoculation was added. I presume it was part of the compost that had been prepared previously.

Q. What is your opinion as to the value of the compost tests referred to in the bulletin?

812 A. Well, the compost tests were actually a test comparable to planting the legume plants actually in a seed inoculant. That is, he had the product which was prepared in accordance with the specifications—essentially prepared in accordance with the specifications of the Manns' patent, product one of the Manns patent, and 8,000 gallons of this product was placed in 4-gallon jars, and seeds were planted in these jars, and the results obtained were not significant inasmuch as there were no uninoculated sterile controls.

However, there were a few composts in his series to which no uninoculated soil had been added. However, the percentage of plants in which nodules were observed in the composts prepared with the well inoculated soil is about the same as the percentage of plants with nodules that were in the composts prepared without the well inoculated soil, indicating that the condition of the well inoculated soil with the product did not—so far as the test is concerned, actually did not alter the product in any substantial way.

Q. Will you please discuss the sterile sand experiment?

A. The sterile sand experiment had apparently no—as far as the bulletin states there are no uninoculated sterile controls, and plant 7 which has been referred to shows pictures of the various plants which had been inoculated, but there is no picture of the control. Whether or not the author ran a control I do not know, but if he did not run a control he has no assurance of where these bacteria came from. There is no indication that the seed was sterilized. There is no indication that the water used to water the plants was sterilized. And if the author did have a sterile control there is no indication of it in the bulletin and it is not in his pictures.

Q. Now, does this bulletin and the Manns patent contain any teachings which would assist one skilled in the art to produce a successful mixed culture for leguminous plants as distinguished from a single culture?

A. No.

The Court: Q. Well, what have you to say about this second paragraph on page 25?

A. Page 25? You mean "it has been inferred", that part, "it has been inferred by certain producers of commercial inoculants that the organism of each particular legume requires a culture medium slightly different from that of another, and particularly adapted for the organism in question."

Well, we know that certain groups of the root nodule bacteria grow better on one type of media, whereas another group may grow better on the second type. However, all the groups will grow readily on a given medium if it is properly prepared.

Going on with that further, "that 'the germs for one variety of legumes will not work on any other variety of legume'" is the generally accepted opinion in the art at this time, that is, with respect to cross-inoculation groups. There is an occasional exception where the bacteria from one cross-inoculation group will form nodules on a second, but it is a very rare occurrence, especially in agricultural legumes of commercial importance. It is more common with wild legumes. There may be something to the evolution of organism that has something to do with that. We do not fully understand just w' causes that, but it is a very rare occurrence. I have never run into it and I know of no reported tests where a substantial amount nodulation was obtained, where definitely pure cultures of alfalfa bacteria were put on

red clover plants or on soy bean plants and nodules were formed on those plants.

In the light of recent investigation it is shown that the organisms for different groups of important legumes may be successfully carried in one and the same composts. This particular bulletin shows that several groups, different groups of the legumes have been placed in this compost and he was able to get nodule formation on his plants. That is, inasmuch as we assume that he had sterile controls on which he found no nodules formed. I mean, this is the author's conclusion from his experiments. On the basis that he had sterile controls on which no nodules were formed, it would mean that a compost freshly prepared might have sufficient organisms in it to form nodules on a few of the groups that he tested, for that is all the bulletin shows, and inasmuch as the bulletin does not show any uninoculated controls there is no way of knowing whether the author's conclusions are valid or not.

816 The Court: Where he says it may be successfully carried in one and the same compost.

The Witness: He is referring to the humus mixture.

The Court: Yes, I know what he is referring to there, but does it mean that he has got a combination of cultures there that work on different varieties of these plants?

The Witness: Well, I did not quite understand the whole paragraph. I don't follow exactly what the first part of the paragraph has to do with the second, but I do not believe the author is intending to imply that one organism will inoculate all the different varieties. Now, this is my interpretation of what the author thinks.

The Court: I know, but isn't he telling you there that he has found the composite group will work when used together?

The Witness: That is the conclusion of the author, yes. The validity of that conclusion, based on the data presented in the bulletin, is subject to question, but even assuming it were correct, that is all the farther he has gone. He says you can put these different cultures

817 in the one mixture and get nodules sometimes, and as far as the claims of the mixed culture in the Bond patent are concerned, we go farther than that. We do admit that mixed cultures were in existence prior to 1[illegible] and the newness isn't the mere presence of the

organisms in the mixture, but the introduction of new material is the preparation of mixed culture in such a way, containing selected strains of organisms, so that a maximum job can be done.

There were indications that when these mixtures were made that the efficiency of these individual strains, individual species in that culture, were reduced. The literature indicated that, and the other experiments have shown that, too, and the result is that unless these are carefully selected strains that we know are not—will not inhibit each other, will not reduce their efficiency, that is, will not change from good to poor when you mix them together, is the only way a good commercial mixed product could be made.

Mr. Thiess: Q. And there is no teaching of that 818 in the Manns' patent or in the bulletin?

A. There is nothing about that. It is purely a mixture of the bacteria together. Of course, there is nothing new about that, a mere mixture of the different species of bacteria.

Q. That was done in the garden cultures, wasn't it?

A. That has been done for a long time, yes, and that is all that is indicated there.

Q. Now, Mr. Bond, I would like to ask you this question: You have been accused here with making a false statement deliberately in your patent, and I want to ask you if you deliberately made any statement in your patent that you knew was not true?

A. Absolutely none.

Q. And prior to your investigation of the literature in 1937, did you believe that mixed strains in a culture would inhibit their nitrogen fixing ability?

A. If someone had asked me that prior to my investigation of the literature, I would say that I had no basis for believing that such were true.

Q. But after your investigation of the literature—

A. To me it definitely indicated that the existence of antagonistic strains or inhibitive strains were 819 very prevalent. There was absolutely no indication in the literature that when a mixture was mixed together, that the strains would not be affected; that is, their efficiency would be reduced.

Q. Will you please refer to these pages, 135 and 136, of the publication of Fred, Baldwin, and McCoy; and this, as I understand, refers to the general grouping of

organisms. No, will you just refer to that statement and tell me what this book says there in this quotation on pages 135 and 136?

A. Well, on pages 135 and 136, I presume you are interested in the paragraph starting with "Morthology and flagellation", is that correct? If you want me to tell you what the pertinent part is, I have no objection to doing so. I am trying to find out what part of pages 135 and 136 you want. I can read them all.

Q. You might read those right on.

A. Essentially, looking at the pages, it is referring to two different groups of the root nodule bacteria. They have been classified into two groupings. One of these groups has certain morphological characteristics and
820 certain physiological and cultural characteristics.

The other group varies in those particular characteristics, and in the first group are included the alfalfa, clover, bean,—they are the most prominent, well known organisms that are in that group. They are the fast growing group. They form more mucus, slimy material in the growth. They are also characterized by the formation of what is known as a serum zone in a litmus milk tube. This is a physiological test. And they are also characterized by their merititious coagulation. The other group, on the other hand, is morphotitious in respect to coagulation, does not form a serum zone in litmus milk, is relatively slow growing in comparison. That group includes cow peas, soy bean and lupine.

This discussion on pages 135 and 136, refers to these cultural and morphological groups, which means their shape and size and characteristic, and has nothing to do with mixing them together, because the different species happen—four of the species happen to be fast growing and two or three of the others are slower growing. They put them in these groups. It was easier
821 by the last test to decide what they were and it is merely distinguishing between the two groups. It has nothing whatsoever to do with mixing them together on composite cultures. There is no correlation there at all.

Q. Is there any teaching in these pages about inhibition?

A. No, absolutely none.

Mr. Greer: I think it is fair to Mr. Bond to call attention to why I introduced page 136. I did not in-

troduce page 135 at all, and the only part of page 136 that I wanted to bring to the Court's attention is the sentence in the second full paragraph on that page, reading: "In some cases, the variation between the reaction of known strains of the same Rhizobium is so great that apparent differences between cross-inoculation groups cannot be urged too far."

Mr. Greer: Page 136, in the middle of the page, approximately. It is the second sentence, in the second full paragraph on page 136.

822 Mr. Thiess: Q. Now, will you discuss that statement in connection with the context on that page and the prior page?

A. This statement refers to the characterization of the organisms solely by means of their cultural and physiological characteristics. The best method for distinguishing between, say, an alfalfa species and soy bean species is actually to try them on the plants, but by means of these physiological and cultural tests you can frequently distinguish between the soy bean bacteria and the alfalfa bacteria; but occasionally, as it says here, in some cases the variation between the reaction of known strains of the same Rhizobium is so great that apparent differences between cross-inoculation groups cannot be urged too far.

Essentially the authors are stating that the bacteria should not be classified in different species solely on the basis of their cultural characteristics and that further tests should be conducted on the plants. That is essentially what they are referring to here in that particular statement.

Mr. Thiess: That is all.

823 Mr. Greer: No cross-examination.

Mr. Rathburn: There are two more minor short admissions that I would like to read into the record, your honor, along with the responses. The request No. 73, the statement, rather, which plaintiff requested the defendant to admit:

"Prior to the Bond patent, in suit 2,220,812, the Albert Dickinson Company, Chicago, Illinois, had not manufactured and sold any mixed culture of two or more species of root nodule bacteria other than garden culture."

The answer by defendant is:

"For response to request for admission No. 73, the

defendant is advised and believes that the Albert Dickinson Company, of Chicago, Illinois, prior to the date of the application or issue of the Bond patent in suit, had not manufactured and sold any mixed culture of two or more strains or species of root nodule bacteria other than the 'garden size package' culture."

Request No. 74:

"Prior to the Bond patent in suit, No. 2,220,812, Agricultural Laboratories, Inc., Columbus, Ohio, had
824 not manufactured and sold any mixed culture of two or more species of root nodule bacteria other than garden culture."

Defendant's response:

"The response to request for admission No. 74 is the same as that of the response to request for admission No. 73."

Mr. Thiess: Plaintiff rests.

Mr. Greer: Defendant rests.

Whereupon both sides rest.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

I, Kenneth J. Carrick, Clerk of the United States Circuit Court of Appeals for the Seventh Circuit, do hereby certify that the foregoing printed pages contain a true copy of Volume 1 of the Printed Record, being one of 2 Volumes of said Printed Record filed on October 19, 1946, in:

Cause No. 9040-41.

Kalo Inoculant Company,
Plaintiff-Appellant,

vs.

Funk Brothers Seed Company,
Defendant-Appellee;

and

Kalo Inoculant Company,
Plaintiff-Appellee,

vs.

Funk Brothers Seed Company,
Defendant-Appellant,

as the same remains upon the files and records of the United States Circuit Court of Appeals for the Seventh Circuit.

In Testimony Whereof I hereunto subscribe my name and affix the seal of said United States Circuit Court of Appeals for the Seventh Circuit, at the City of Chicago, this 1st day of August, A. D. 1947.

Kenneth J. Carrick,
(Seal) *Clerk of the United States Circuit Court of Appeals for the Seventh Circuit.*